

T H E
Expeditious Accountant;

O R,

CYPHERING RENDERED *so short,*

That Half the Trouble attending the common Methods is saved, in most Occurrences; and *so easy*, that a Person of moderate Capacity may learn with very little Assistance from a Master; the Rules given being plain, the Examples properly illustrated, and Numbers of Questions, with their Answers, being annexed to them, to exercise the Learner.

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Totally different from all that have preceded it.

I N F I V E P A R T S.

By **NICHOLAS SALOMON**, K

Master of the Academy, *Red-Lion-Street, Clerkenwell;*
And AUTHOR of *The French Teacher's Assistant*, and of *The Rules for the French Genders*.

✱ HAVING perused the Manuscript of the above-mentioned Treatise of Arithmetic, I do allow the Operations to be worked in a very easy, curious, and expeditious Manner; and, as each Rule is well illustrated, I beg Leave to recommend it, as the most useful Book for Learners extant, both for Mercantile Business, and as an Introduction to Mathematics.

L. LOCHEE,

Master of the Military Academy, at Little Chelsea.

Quid munus reipublicæ majus meliusve afferre possumus, quam si juventutem bene erudiamus?

CICERO.

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12 JU 62

To the REVEREND and WORTHY
SCHOOL-MASTERS in *Great-
Britain and Ireland.*

GENTLEMEN,

THE following Work is with a View to create, in the *British* Youth, an Ambition to excel in, and make themselves ready at, *Mercantile Computations*: Mine will be amply gratified if you, approving of the Plan, think it worthy of your Suffrage; nor shall I wish for a better Reward for the Trouble I have taken, than the conscious Satisfaction of having improved upon our Profession, and discharged that Duty which behoves every Master to contribute, to carry it to its Perfection.

There is something new in almost every Rule *, which, besides, I have done my Endeavours to elucidate, and render more *exact*, *easy*, and *short*, than former Authors have done. Whether I have succeeded in my Attempt, I refer to your impartial Judgement, and will entirely submit to it.

I can not conclude without adding, that I hope you will excuse the false Figures or Transpositions, which, in so difficult a Work (in printing, and at a first Edition) will infallibly creep in unobserved †; and assuring you, at the same Time, that, as public Utility is, and always shall be, the only Object of my Concerns, so, your kind Admonitions will be highly acceptable to, and faithfully noticed by,

GENTLEMEN,

Your most devoted, humble Servant,

NICHOLAS SALOMON.

* See *Addition, Subtraction, the Rule of Three, Reduction, Practice, the Rule of Hundred* (with those which relate to it, as *Interest, Commission, Stock jobbing, Brokage, Insurance,*) *Alligation, &c.*

† All those Errors which I have discovered, I have taken notice of after the Index. See Page the last.

A LIST

THE FIRST PART.

ARITHMETIC in WHOLE NUMBERS.

The INTRODUCTION.

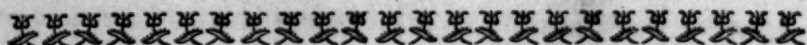
ARITHMETIC is the Art of counting with Exactness, or the true and just Knowledge of NUMBERS.

That SCIENCE has four fundamental Rules, viz. ADDITION, SUBTRACTION, MULTIPLICATION, and DIVISION.—And these four Rules are reduced to two principal Objects, viz. INCREASING and DECREASING.—By *Addition* and *Multiplcation*, Numbers are *increased*; and, on the contrary, by *Subtraction* and *Division*, they are *decreased*.

A NUMBER is a Quantity that expresses and represents one or more Units; and all Number can be expressed and represented by the ten following *Arabian Characters*, viz.

0	1	2	3	4	5	6	7	8	9		
Nought	or	Cypher,	one,	two,	three,	four,	five,	six,	seven,	eight,	nine,

These Figures *increase* or *decrease* according to their Position, as may be perceived in the Numeration Table.



NOTATION or NUMERATION.

NUMERATION teaches to READ or WRITE any *Number* known or proposed.

CASE I. How to read any Number.

RULE. Divide it by Commas into Classes of three Characters each, beginning at the Right-Hand.—Over the Right-Hand Figure of the third Class, make a Point: over that of the fifth, two Points: over that of the seventh, three Points: &c.—The Number to the Left-Hand of the first Comma, expresses by *Thousands*: that which has over it the first Point, by *Millions*: that which has over it two Points, by *Billions*: that which has over it the third Point, by *Trillions*: &c.—The Left-Hand Character of each Class, expresses by *Hundreds*: the Middle one by *Tens*; and, the Right-Hand one by *Units*.

THE NUMERATION TABLE.

1st	Units	} 1st Class	4
2d	Tens		32
3d	Hundreds		654
4th	Thousands	} 2d	1, 987
5th	Tens of Thousand		23, 406
6th	Hundreds of Thousand		780, 123
7th	Millions	} 3d	4, 507, 891
8th	Tens of Million		23, 456, 070
9th	Hundreds of Million		144, 878, 897
10th	Thousands of Million	} 4th	1, 560, 579, 009
11th	Tens of Thous. of Million		42, 049, 054, 104
12th	Hund. of Thous. of Mill.		406, 787, 806, 090
13th	Billions	} 5th	7, 891, 000, 567, 839
14th	Tens of Billions		23, 056, 089, 102, 001
and so on as in Millions			

From six to six, *Trillions*, *Quadrillions*, *Quintillions*, *Sixtrillions*, *Septillions*, *Octillions*, *Nontillions*, &c. *ad Infinitum*.

EXAMPLE.

Read this Sum 7891234567891456

7, 891, 234, 567, 891, 456

ANSWER. Seven Thousand of BILLION, eight Hundred and ninety one BILLIONS, two Hundred and thirty-four Thousand of MILLION, five Hundred and sixty-seven MILLIONS, eight Hundred and ninety one THOUSAND, four Hundred and fifty-six.

Though

NUMERATION.

3

Though the Scholar may be amply exercised by reading the Sums of the Numeration Table, yet I think it will not be amiss to give the following

QUESTIONS TO EXERCISE THE LEARNER.

Read this Quantity 34678

Read this Sum 45767894

Read this Sum 3070040794

Read this Quantity 500475

Read this Sum 3705009

Read this Sum 3950790004

Read this Quantity 5704078

Read this Sum 458004

Read this Sum 50047050078045904

CASE II. How to write any Number.

RULE. To write down any proposed Number, reverse the Rule for CASE I. and, if any intermediate Place is wanting, fill it up with the Cypher (0).

EXAMPLE.

Write down in Figures: *fifty Thousand of Billion, four Hundred and six Billions, thirty Thousand of Million, sixty Millions, one Thousand and four.*

ANSWER. 50, 400, 030, 060, 001, 004

QUESTIONS TO EXERCISE THE LEARNER.

Write down in Figures: *fourty-nine Thousands, five Hundred and six.*

Write down in Figures: *fourty-five Thousand of Million, three Hundred and seven Million, fifty Thousand, five Hundred and six.*

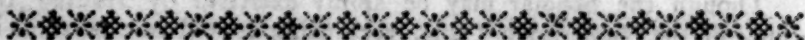
Write down in Figures: *four Hundred and five Millions, ninety-three Thousands, and seventy-nine.*

Write down in Figures: *eighty Billions, fourty-four Thousand of Million, three Hundred Millions, two Hundred and four Thousands, five Hundred and three.*

Write down in Figures: *five Hundred and six Thousand of Billion, fifty-seven Billions, one Hundred and four Thousand of Million, ninety-four Millions, three Hundred of Thousand, three Hundred and nine.*

N. B. It is obvious from the Table, that all Numbers increase in a decuple* Proportion; and consequently, that in a Series of Numbers, every Figure hath a Local, as well as a simple Value. Hence Cyphers, though they have no simple Value, when annexed to significant Figures, remove those Figures so many steps from the Unit's Place, and increase their Value accordingly.

* Of ten.



A D D I T I O N,

Teacheth to find the Total of several Quantities, given to be joined together.

N. B. This (+) is the Sign of Addition, and signifies *More*.
This (=) signifies *Equal*.

RULE. Write down the Quantities given in such a Manner, that *Units* be under *Units*, *Tens* under *Tens*, *Hundreds* under *Hundreds*, *Thousands* under *Thousands*, &c. and draw two Lines under them. Then, beginning on the Right-Hand, cast up every Row; write under it and the first Line what is *under* or *above* 10, also what is *above* 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, &c. and, carry and write under the second Line, at the next Row (except in the last Row, where the Tens are to be prefixed to their Units), 1 for 10, 2 for 20, 3 for 30, 4 for 40, 5 for 50, 6 for 60, 7 for 70, 8 for 80, 9 for 90, 10 for 100, 11 for 110, 12 for 120, &c. observing, that you are to carry one for every Ten, as *Ten is the universal Ratio in Whole Numbers*.

For **PROOF**. Make another Addition, beginning, on the contrary, by the first Row, Left-Hand: if to the Amount of each (Row), joining the Figure that is under the second Line, it comes up to the same Quantity as that expressed by the Figure under the first Line, the Operation is right.

N. B. In the Practical Way of adding, they set down only what is under or over Ten or Tens, and carry in Mind the Tens without writing them down; in which Case, they make the Proof by another Addition and in the following Manner: if, to find the Total, they have begun to add, from Bottom to Top; *for Proof*, they begin again to cast up; but, then from Top to Bottom, still carrying the Tens in Mind; and if, on the contrary to find the Total, they have begun to add from Top to Bottom; *for Proof*, they begin again to cast up; but, then from Bottom to Top. And if, both Ways, the Total is the same, they account the Operation to be right.—After this Method, a Master should make his Scholars work a few Operations, when he finds them perfected in that which I have laid down; and yet, he must not neglect now and then to make them follow my Method, as it will prove very useful in tedious and long Additions, especially when the Accountant may happen to be disturbed in the Course of his Operation. A 10 Years Experience in a capital Counting-House, where I had nothing to do but Accounts, and all very complicate indeed, has made me adopt it, and I can not too much recommend it.

IN WHOLE NUMBERS.

5

AN ADDITION TABLE.

are		are		are		are	
1 = 3		3 = 6		4 = 8		5 = 10	
2 = 4		4 = 7		5 = 9		6 = 11	
3 = 5		5 = 8		6 = 10		7 = 12	
4 = 6		6 = 9		7 = 11		8 = 13	
5 = 7		7 = 10		8 = 12		9 = 14	
6 = 8		8 = 11		9 = 13		10 = 15	
7 = 9		9 = 12		10 = 14		11 = 16	
8 = 10		10 = 13		11 = 15		12 = 17	
9 = 11		11 = 14		12 = 16		13 = 18	
10 = 12		12 = 15		13 = 17		14 = 19	
11 = 13		13 = 16		14 = 18		15 = 20	
12 = 14		14 = 17		15 = 19		16 = 21	
13 = 15		15 = 18		16 = 20		17 = 22	
14 = 16		16 = 19		17 = 21		18 = 23	
15 = 17		17 = 20		18 = 22		19 = 24	
16 = 18		18 = 21		19 = 23		20 = 25	
17 = 19		19 = 22		20 = 24		21 = 26	
18 = 20		20 = 23		21 = 25		22 = 27	
19 = 21		21 = 24		22 = 26		23 = 28	
20 = 22		22 = 25		23 = 27		24 = 29	
21 = 23		23 = 26		24 = 28		25 = 30	
22 = 24		24 = 27		25 = 29		26 = 31	
23 = 25		25 = 28		26 = 30		27 = 32	
24 = 26		26 = 29		27 = 31		28 = 33	
25 = 27		27 = 30		28 = 32		29 = 34	
26 = 28		28 = 31		29 = 33		30 = 35	
27 = 29		29 = 32		30 = 34		31 = 36	
28 = 30		30 = 33		31 = 35		32 = 37	
29 = 31		31 = 34		32 = 36		33 = 38	
30 = 32		32 = 35		33 = 37		34 = 39	
31 = 33		33 = 36		34 = 38		35 = 40	
32 = 34		34 = 37		35 = 39		36 = 41	
33 = 35		35 = 38		36 = 40		37 = 42	
34 = 36		36 = 39		37 = 41		38 = 43	
35 = 37		37 = 40		38 = 42		39 = 44	
36 = 38		38 = 41		39 = 43		40 = 45	
37 = 39		39 = 42		40 = 44		41 = 46	

Observe that 3 and 2 is the same thing as 2 and 3; 4 and 3 is the same as 3 and 4; &c.

AN ADDITION TABLE.

	are		are		are		are
6	= 12	7	= 14	8	= 16	9	= 18
7	= 13	8	= 15	9	= 17	10	= 19
8	= 14	9	= 16	10	= 18	11	= 20
9	= 15	10	= 17	11	= 19	12	= 21
10	= 16	11	= 18	12	= 20	13	= 22
11	= 17	12	= 19	13	= 21	14	= 23
12	= 18	13	= 20	14	= 22	15	= 24
13	= 19	14	= 21	15	= 23	16	= 25
14	= 20	15	= 22	16	= 24	17	= 26
15	= 21	16	= 23	17	= 25	18	= 27
16	= 22	17	= 24	18	= 26	19	= 28
17	= 23	18	= 25	19	= 27	20	= 29
18	= 24	19	= 26	20	= 28	21	= 30
19	= 25	20	= 27	21	= 29	22	= 31
20	= 26	21	= 28	22	= 30	23	= 32
21	= 27	22	= 29	23	= 31	24	= 33
22	= 28	23	= 30	24	= 32	25	= 34
23	= 29	24	= 31	25	= 33	26	= 35
24	= 30	25	= 32	26	= 34	27	= 36
25	= 31	26	= 33	27	= 35	28	= 37
26	= 32	27	= 34	28	= 36	29	= 38
27	= 33	28	= 35	29	= 37	30	= 39
28	= 34	29	= 36	30	= 38	31	= 40
29	= 35	30	= 37	31	= 39	32	= 41
30	= 36	31	= 38	32	= 40	33	= 42
31	= 37	32	= 39	33	= 41	34	= 43
32	= 38	33	= 40	34	= 42	35	= 44
33	= 39	34	= 41	35	= 43	36	= 45
34	= 40	35	= 42	36	= 44	37	= 46
35	= 41	36	= 43	37	= 45	38	= 47
36	= 42	37	= 44	38	= 46	39	= 48
37	= 43	38	= 45	39	= 47	40	= 49
38	= 44	39	= 46	40	= 48	41	= 50
39	= 45	40	= 47	41	= 49	42	= 51
40	= 46	41	= 48	42	= 50	43	= 52
41	= 47	42	= 49	43	= 51	44	= 53
42	= 48	43	= 50	44	= 52	45	= 54

EXAMPLE.

IN WHOLE NUMBERS, 7

EXAMPLE.

What is the Total of these Quantities: $1985 + 88976 + 76446 + 68459$?

$$\begin{array}{r}
 1985 \\
 88976 \\
 76446 \\
 68459 \\
 \hline
 \text{Total} \quad - \quad - \quad - \quad 235866 \\
 \hline
 \text{Numbers carried} \quad - \quad - \quad - \quad 2222
 \end{array}$$

ILLUSTRATION.

Having disposed the Quantities in such a Manner, that each Figure be to its proper Column, i. e. *Units* under *Units*, *Tens* under *Tens*, *Hundreds* under *Hundreds*, &c. I draw two Lines under them; the first, to write under it the Numbers under or above *Tens*; and the second, to set under it the *Tens* that I carry to next Column. —Then, beginning by the Column of the Right-Hand or *Units*, 9, 6, 6, 5, I cast them up; saying, 9 and 6 are 15 and 6 are 21 and 5 are 26; for which, I write 6 that are above *Tens* at the Column of *Units*, under the first Line; and as there are two *Tens* in 26, I carry and write down 2 at the Column of *Tens*, under the second Line; so that I may always see 26; thus, ($\frac{6}{26}$).

I cast up, afterwards, the Column of *Tens*, in the same Manner as I did the *Units*; and I find that 2 (of the second Line), that I carry and 5, 4, 7, 8, amount again to 26; therefore I write down 6 under the first Line, and 2 under the second, for the two *Tens*, which I place at the Column of *Hundreds*.

I proceed to the Column of *Hundreds*, and casting 2, that I carry (from under the second Line), and 4, 4, 9, 9, I find 28; therefore write 8 under the first Line, and 2 under the second, which I place at the Column of *Thousands*.

At the Column of *Thousands*, I have 2 that I carry (from under the second Line), and 8, 6, 8, 1, which all amount to 25; therefore I write 5 under the first Line, and as there are again 2 *Tens* besides, I carry 2, which I place at the Column of *Tens of Thousand* under the second Line.

Finally, coming to the Column of *Tens of Thousand*, and adding up 2, that I carry, from under the second Line), and 6, 7, 8, I find 23; which I write in full under the first Line, it being the Sum of the last Column.

Thus,

Thus, I find, that the four above given Quantities amount together to *two Hundred and thirty-five Thousand, eight Hundred and sixty-five*; of which to make

THE PROOF

I begin, on the contrary, by the *first Column* Left-Hand, and cast up the Figures; thus, $8 + 7 + 6 = 21$ and 2 (under the second Line), $= 23$, which I see under the first Line.—At the *second Columns* $1 + 8 + 6 + 8 = 23$ and 2 (under the second Line), are 25, equal to the 5 under the first Line at that Column, and the 2 Tens standing at the fore Column, Left-Hand, under the second Line.—At the *third Column*: $9 + 9 + 4 + 4 = 26$ and 2 (under the second Line), are 28, equal to the 8 under the first Line at that Column, and the 2 Tens standing at the fore Column, under the second Line.—At the *fourth Column*: $8 + 7 + 4 + 5 = 24$ and 2 (under the second Line), are 26, equal to the 6 under the first Line, and the 2 Tens standing at the fore Column under the second Line.

And, having thus joined the Figure that is under the second Line, to the Amount of each Column, I have found that each Total was equal to that expressed under the 1st Line; which shews the Operation was right.

OTHER EXAMPLES.

4	67	346	7894	7847
7	46	279	1590	1594
6	8	678	876	3897
8	76	69	497	597
Total —	9	109	67	6754
25		46	8479	389
Total	206	Total	3847	476
	3	1527	Total	67
		34	23250	21621
			454	465

QUESTIONS TO EXERCISE THE LEARNER.

I. I have sold 4lbs. of Cheese to A; + 7lbs. to B; + 8lbs. to C; + 5lbs. to D; + 3lbs. to F; + 9lbs. to G. How many lbs. did I sell in all? Anf. 36.

II. A Man was born in the Year 1708 when will he be 45: Years old? Facit 1753.

III. A Draper has five Pieces of Cloth; the first Piece contains 85 Yards; the second 46; the third 45; the fourth 30 and the fifth 27. How many Yards has he in all? Facit 233.

IV. Received

IN WHOLE NUMBERS. 9

IV. Received £.45 on Monday, 37 on Tuesday, 49 on Wednesday, 117 on Thursday, 9 on Friday, and 78 on Saturday: how much did I receive in all? Facit £.335.

V. Paid this Week, viz. £.35 on Monday, 67 on Tuesday, 46 on Wednesday, 147 on Thursday, 97 on Friday, and 3 on Saturday: what did I pay in all? Facit £.395.

VI. Bought eight Chaldrons of Coals at 32s a Chaldron: how many Shillings did I pay in all? Facit 256s.

Set down 32 eight Times under one another, then add.

VII. Thirty has September,
April, June, and November;
February has twenty-eight alone
All the rest have thirty and one;
Except in Leap-Year, and then's the Time
February's Days are twenty and nine

How many Days are
there in a Leap-Year
then? Facit 366 Days.

Set down the Days of every
Month under one another (29
for February), then add.

VIII. There are three Numbers: the first 307; the second 147; and the third is as much as the other two: what is the Sum of them all? Facit 908.

Add the 1st and 2d together; you'll find 454, which Total, being likewise the 3d Number, added to itself 454 will give the Answer.

IX. A Farmer has eight Fields: in one Field are 27 Acres: in another, 69: in another, 47: in another, 29: in another, 147: in another, 8: in another, 75: in another, 107: how many Acres has he in all? Facit 509.

X. How many Miles are there from London to Harwich, there being from London to Rumford, 11 Miles; from Rumford to Brentwood, 6; from Brentwood to Colmsford, 11; from Chelmsford to Witham, 8; from Witham to Kelvedon, 4; from Kelvedon to Colchester, 10; from Colchester to Manningtree, 9; and from Manningtree to Harwich, 12? Facit 71.

XI. How far is it from London to Carlisle in Cumberland, when, from London to Newcastle there are 149 Miles: from Newcastle to Preston, 62; from Preston to Lancaster, 21; from Lancaster to Penrith, 50; from Penrith to Carlisle, 19? Facit 301.

XII. From the 17th of November 1772 to the 12th of September 1773, how many Days? Facit 299.

From the 17th of November to the 30th included, you'll find 14 Days, which set down, as likewise under them 31 for December, 31 for January, 28 for February, 31 for March, 30 for April, 31 for May, 30 for June, 31 for July, 31 for August, and the 11 first Days of September; then add.

XIII. From the 18th of July 1773 to the 27th of December, the same Year, how many Days? Facit 162.

Add the 14 last Days of July, and 31 of August, 30 of September, 31 of October, 30 of November, and the 26 first of December, together.

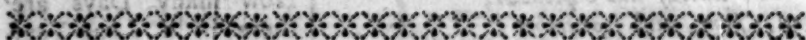
• C

XIV. There

XIV. There are $234 + 547 + 349 + 1047 + 9 + 408 + 49 + 19 + 7$, to be added to 3079; what will be the Total? Facit 5748.

XV. Six School fellows went to play at Marbles together. John won 13 of Henry, 19 of Philip, 6 of Edward, 8 of Peter, and 21 of Paul; how many Marbles did he win in all? Facit 67.

XVI. Bought at different Times Sugar: once 46lbs, another Time 9, another Time 16, another Time 60, another Time 6, another Time 38, another Time 44, another Time 147, and another Time 203; how many lbs. did I buy in all? Facit 569.



SUBTRACTION

Teacheth to find the Difference, called the *Remainder*, between a great Number, called the *Minuend*, and a less, called the *Subtrahend*.

This (—) is the sign of Subtraction, and signifies less.

The Addition Table being reversed, will, in the following Manner, give

A SUBTRACTION TABLE.

Remain		Remain		Remain		Remain	
3 from	1	4 from	1	5 from	1	6 from	1
4	2	5	2	6	2	7	2
5	3	6	3	7	3	8	3
6	4	7	4	8	4	9	4
7	5	8	5	9	5	10	5
8	6	9	6	10	6	11	6
9	7	10	7	11	7	12	7
10	8	11	8	12	8	13	8
11	9	12	9	13	9	14	9
Remain		Remain		Remain		Remain	
7 from	1	8 from	1	9 from	1	10 from	1
8	2	9	2	10	2	11	2
9	3	10	3	11	3	12	3
10	4	11	4	12	4	13	4
11	5	12	5	13	5	14	5
12	6	13	6	14	6	15	6
13	7	14	7	15	7	16	7
14	8	15	8	16	8	17	8
15	9	16	9	17	9	18	9

Observe that 3 from 2 is not the same thing as 2 from 3.—7 from 5 is not the same thing as 5 from 7, &c.

CASE I.

IN WHOLE NUMBERS. 11

CASE I. To subtract a single Quantity from a single Quantity.

RULE. Having placed the Quantities as in Addition, observing only that the greater must be at Top and the less under it; write in the Remainder, and join to the Bottom or Subtrahend the Deficiency to come up to the Value of the Top or Minuend. Therefore, if the Figure in the Subtrahend is equal to that in the Minuend, write down 0 in the Remainder: if less, write down the Difference: if greater, suppose the Minuend increased of 10, the universal Ratio in Whole Numbers; then write the Difference in the Remainder, and carry 1 for the Ten.

For PROOF. Adding the Remainder to the Subtrahend, the Total must come equal to the Minuend.

EXAMPLE.

Suppose I had 2267 to deduct from 6434, what will remain?
Facit 4167.

$$\begin{array}{r} 6434 \text{ Minuend.} \\ 2267 \text{ Subtrahend.} \\ \hline 4167 \text{ Remainder.} \end{array} \left. \vphantom{\begin{array}{r} 6434 \\ 2267 \\ 4167 \end{array}} \right\} 6434 \text{ Proof.}$$

ILLUSTRATION to work it by ADDITION.

1st, 4 in the Minuend being less than 7 in the Subtrahend, I suppose the 4 to be increased of 10; and thus making the Minuend 14, I say, $7 + 7$ (Difference to 14), that I write in the Remainder = the 4 which is in the Minuend and 1 Ten that I carry.

2dly, 1, that I carry, $+ 6$ (Subtrahend) = $7 + 6$ that I write in the Remainder, (it being the Difference to 13, supposing the Minuend again increased of 10), = the 3 in the Minuend and 1 Ten that I carry.

3dly, 1, that I carry, $+ 2$ (Subtrahend) = $3 + 1$, that I write in the Remainder (it being the Difference to 4 in the Minuend), = the 4 that I see in the Minuend; and as there is no Ten, I carry nothing.

4thly, 2 (Subtrahend) $+ 4$, that I write in the Remainder (it being the Difference to 6 in the Minuend), = the 6 which I see in the Minuend.

N. B. To work *Subtraction* by *Addition* is certainly the best Way; since, with a little Practice, it will prove a great deal shorter and surer than any other (its Usefulness will be better discovered in the next Case and Division).—Thus, you make the Proof at the same Time that you work the Operation; since, when you write

the Difference and add it to the Figure of the Subtrahend, you are always to find a Value equal to the Figure expressed in the Minuend: but if you have a Mind to be still surer of your Operation, then, according to the common Rule given to prove a Subtraction, add the *Remainder* (in the above Example found to be 4167) to the *Subtrahend* (in the above Example 2267), and you must find the same Sum as the given *Minuend* (in the above Example 6434).

OTHER EXAMPLES.

67484	50002	67456	36454
26487	40008	27457	16452
Remain 40997	9994	39999	20002

CASE II. To Subtract several Quantities from a single Quantity.

RULE. Add the several Sums of the Subtrahend into one Total, which subtract from the Top Line or Minuend, as by CASE I.

Or, to find the Remainder by a Single Operation,

Supposing to the Figures in the Top Line or Minuend as many Tens as the Case may require, write down in the Remainder, and join to the Amount of the Subtrahend at each Row, as much as may be deficient to come up to the Quantity that is expressed in the Minuend; and carry 1 for each Ten.

For PROOF. As in CASE I.

EXAMPLE.

Suppose that, on Account of £. 8468 that I owed, I had paid once £. 2469, another Time £. 854, and another Time £. 646; what do I remain indebted? Facit £. 4499.

BY THE COMMON WAY.

2469	From	£. 8468 the whole Debr.
854	Subtract	£. 3969 Total of the Pay ^{ts} .
646		
Total of the } 3969	Remain	4499 To pay.
Payments }		
PROOF. 4499 + 3969 = 8468 Minuend.		

ILLUSTRATION.

I add all the Payments together; and finding the Total 3969, I subtract it from what I owed, viz. 8468; and thus I find the Remainder to be £. 4499, which is what I remain indebted.

Br

IN WHOLE NUMBERS. 13

BY A SINGLE OPERATION.

I owed	£. 8468	Minuend.	
Paid at different Times	$\left\{ \begin{array}{l} 2469 \\ 854 \\ 646 \end{array} \right\}$	Subtrahend.	} Proof. 8468.
Remains due	£. 4499	Remainder.	

ILLUSTRATION.

1st, Adding the *Subtrahend* $6 + 4 + 9$, I find it $= 19$. Now, as I see 8 in the *Minuend* (less than 19), and find it impossible to pay these 19, without supposing 2 Tens to the 8; so I consider the *Minuend* as being 28 (if the several Sums had come to 29, it would have been necessary to suppose 3 Tens; and, therefore, to consider the *Minuend* as being 38, &c.); then, as in the 1st Case, I say $19 + 9$, to write down (it being the Difference to 28 in the *Minuend*), $=$ the 8 in the *Minuend* and 2 Tens, for which I carry 2.

2dly, 2, that I carry, $+ 4 + 5 + 6$ (*Subtrahend*) $= 17 + 9$, to write down (it being the Difference to 26, supposing the *Minuend* increased of 20), $=$ the 6 in the *Minuend* and 2 Tens, for which I carry 2.

3dly, 2, that I carry, $+ 6 + 8 + 4$ (*Subtrahend*) $= 20 + 4$, to write down (it being the Difference to 24, supposing the *Minuend* increased of 20), $=$ the 4 in the *Minuend* and 2 Tens, for which I carry 2.

4thly, 2; that I carry, $+ 2$ (*Subtrahend*) $= 4 + 4$, to write down (it being the Difference to the last Figure at Top) $=$ the 8 in the *Minuend*.

Thus, I find the Remainder to be, in the above Example, 4499; which (as in Case I.), if you have a mind to prove, add to $646 + 854 + 2469$ (*Subtrahend*), and you'll find the Total 8468, which is the same Sum as the given *Minuend*.

OTHER EXAMPLES.

From	5947	7405	6000	86700
Take	$\left\{ \begin{array}{l} 607 \\ 509 \\ 407 \\ 508 \\ 1303 \end{array} \right\}$	$\left\{ \begin{array}{l} 847 \\ 657 \\ 847 \\ 604 \\ 579 \end{array} \right\}$	$\left\{ \begin{array}{l} 759 \\ 678 \\ 796 \\ 547 \\ 687 \end{array} \right\}$	$\left\{ \begin{array}{l} 4707 \\ 8709 \\ 579 \\ 403 \\ 876 \end{array} \right\}$
Rem.	2613	3871	2533	71426

CASE

CASE III. To subtract a single Quantity from several Quantities.

RULE. Add the several Sums of the Minuend into one Total, from which subtract the Subtrahend, as by CASE I.

Or, to find the Remainder by a single Operation,

RULE I. Find the Difference between 10 (universal Ratio in Whole Numbers) and the Figure of the Subtrahend (if a significant one): join that Difference to the Amount of the Figures of the Minuend, and write down what is under or above Tens.

II. If the Amount of the Minuend is under Ten, carry 1 (provided you have joined something from the Subtrahend): If there is only 1 Ten, carry nothing: If there are 2 Tens, diminish 1 from the next Row of the Subtrahend: If there are 3 Tens, diminish 2: If there are 4 Tens, diminish 3; and so on, observing this

GENERAL RULE

for more Tens at Top, diminish; for less Tens at Top, add.—when the Tens are equal, neither diminish nor carry.

III. If these Units cannot be all diminished from the Subtrahend, there being only 0, or not enough, you must add them or the Difference to the Figures of the Minuend; but then, you are to diminish, in the next Row of the Subtrahend, 1 for each Ten you have had.

IV. If in the Amount of the last Row of the Minuend (after having joined something from the Subtrahend), there is one Ten more than in the Subtrahend, suppress that Ten: If there are 2 Tens more, write down 1 only: If there are 3 Tens more, write down 2 only; and so on, always suppressing 1; which is according to the General Rule.

For PROOF. As in CASE I.

EXAMPLE.

Suppose I had drawn upon my Banker, once £.646, another Time £.98, another Time £.64, and another Time £.59.—And that I should remit to him £.543; how much shall I owe him then? Facit £.324.

BY THE COMMON WAY.

£.646	From the Total of my Draughts £:867	
98	I subtract the Remittance	543
64		
59	Remain due to my Banker	£.324
	867 Total of my Draughts.	

Proof.
867

By

IN WHOLE NUMBERS. 15

BY A SINGLE OPERATION.

$$\begin{array}{r} \text{Drawn at different Times} \left\{ \begin{array}{l} 646 \\ 98 \\ 64 \\ 59 \end{array} \right\} \text{Minuend.} \end{array}$$

Proof.

867

$$\begin{array}{r} \text{Remitted once} \quad \quad \quad \text{£. 543} \quad \text{Subtrahend.} \\ \text{Remains due} \quad \quad \quad \text{£. 324} \quad \text{Remainder.} \end{array}$$

ILLUSTRATION.

To obtain the Remainder, by a Single Operation,

1st, I say 10 (universal Ratio in Whole Numbers, and here *supposed Subtrahend*) less 3 (*given Subtrahend*) = 7, which Difference adding to 9 + 4 + 8 + 6 (*Minuend*), I find = 34. Therefore, I write 4 in the Remainder; then, from 3 Tens taking off 1 Ten that I had in the *supposed Subtrahend*, it remains 2, which deducting from 4, next Figure in the *Subtrahend*, the said next Figure (4) will be worth 2 only.

2dly, 10 (*supposed Subtrahend*) — 2 (remaining of the *given Subtrahend* 4) = 8, which Difference adding to 5 + 6 + 9 + 4 (*Minuend*) = 32. Therefore, I write 2 in the Remainder; then, as above, it remains 2 Tens, which deducting from 5, next Figure in the *Subtrahend*, the said 5 will be worth 3 only.

3dly, 10 (always *supposed Subtrahend*) — 3 (remaining of the *given Subtrahend* 5) = 7, which Difference adding to 6 (*Minuend*) = 13. Therefore, I write down 3 in the Remainder.—And, as Tens are equal, that is, as there is one Ten both at the *Top* or *Minuend*, and at the *Bottom* or *Subtrahend*, so I suppress the Ten, which, again, is according to the 4th Rule.

Thus, I find the Remainder to be £. 324; which (as in CASE I.) if you have a Mind to prove, add the *Minuend* 646 + 98 + 64 + 59 together, you will find the Sum £. 867.—And, adding likewise the Remainder £. 324 to the *Subtrahend* £. 543, you will find the same Sum as the *Minuend* produced, viz. £. 867.

OTHER EXAMPLES.

	649	469	579	807
	454	376	468	605
From	687	468	376	407
	588	679	459	509
	289	389	678	407
	754	649	759	608
Take	2049	1704	817	1509
Rem.	1372	1326	2502	1834

CASE

CASE IV. To subtract several Quantities from several Quantities.

RULE. Add the several Sums of the Minuend into one Total, and the several Sums of the Subtrahend also into one Total. Afterwards subtract the Total of the Subtrahend from the Total of the Minuend.

Or, to find the Remainder by a Single Operation,

RULE I. Cast up at each Row the Figures of the Subtrahend: in their Amount consider what is deficient to come up to the next Ten (universal Ratio in Whole Numbers); which Difference join to the Figures of the Minuend, and write in the Remainder the Units of the Total of each Row of the said Minuend.

II. If there are more Tens in the Minuend than in the Subtrahend (brought to Tens), diminish the Difference from the next Row of the Subtrahend; but, if there are not so many Tens in the Minuend, on the contrary, add that Difference to the said next Row of the Subtrahend, i. e. *take from the Bottom Quantities or Subtrahend as many Units as there are Tens more in the Top Quantities or Minuend*, which is according to this

GENERAL RULE.

For more Tens at Top diminish; and, for less Tens at Top add.—When Tens are equal, neither diminish nor carry.

III. When the Difference can not be diminished from the next Row, and, with Respect to the Tens of the Amount of the last Row, observe the 3d and 4th Rules of the last Case.

For PROOF. As in CASE I.

EXAMPLE.

Suppose I had borrowed of a Friend once £. 54, another Time £. 36, another Time £. 44; and that I had paid him once £. 36, another Time £. 24, and another Time £. 16: how much should I owe him still? Facit £. 58.

BY THE COMMON WAY.

Sums borrowed	Payments	Then by Subtraction
Add - - 54	Add - 36	From 134 Total borrowed
36	24	Take 76 } Total paid
44	16	— } Proof 134
—	—	Rem. 58
Total — 134	Total - 76	

This requiring no other Illustration, I will proceed with shewing how it may be done

IN WHOLE NUMBERS. 17

BY A SINGLE OPERATION.

Borrowed at different Times	$\left\{ \begin{array}{r} 54 \\ 36 \\ 44 \end{array} \right\}$	Minuend	Proof
			134
Paid at different Times	$\left\{ \begin{array}{r} 36 \\ 24 \\ 16 \end{array} \right\}$	Subtrahend	
Remains due	58	Remainder	134

ILLUSTRATION.

To obtain the Remainder by a Single Operation.

1st, I say, $6 + 4 + 6$ (*given Subtrahend*) = 16, and from 16 to 20 (here to be the *Supposed Subtrahend*, as 20 is the next Ten to 16) the Difference = 4, which Difference adding to $4 + 6 + 4$ (*given Minuend*) = 18. Therefore, I write 4 in the Remainder; and, as in the Bottom or Subtrahend I had 2 Tens, and only 1 in the Top or Minuend, so, according to the second Rule, I am to add 1 to the next Row.

2dly, 1, that I carry, $+ 1 + 2 + 3$ (*given Subtrahend*) = 7, and from 7 to 10 (here to be the *Supposed Subtrahend*, as 10 is the next Ten to 7) the Difference = 3, which Difference adding to $4 + 3 + 5$ (*given Minuend*) = 15. Therefore, I write 5 in the Remainder; and, as Tens are equal, that is, as there is one Ten both in the Top or Minuend and in the Bottom or Subtrahend, so, I suppress the Ten.

Thus, I find the Remainder to be £. 58, which (as in CASE 1) if you have a Mind to prove, add the Minuend $54 + 36 + 44$, together, you will find the Sum of £. 134.—And, adding likewise the Subtrahend $36 + 24 + 16$ to the Remainder 58, you will find the same Sum as the Minuend produced, viz. £. 134.

OTHER EXAMPLES.

From	$\left\{ \begin{array}{r} 30409 \\ 40603 \\ 20403 \\ 90609 \\ 10407 \end{array} \right\}$	$\left\{ \begin{array}{r} 40300 \\ 30909 \\ 34604 \\ 92467 \\ 92346 \end{array} \right\}$	$\left\{ \begin{array}{r} 67547 \\ 34769 \\ 57684 \\ 30794 \\ 59768 \end{array} \right\}$
Take	$\left\{ \begin{array}{r} 10203 \\ 20304 \\ 30406 \\ 30402 \\ 10609 \end{array} \right\}$	$\left\{ \begin{array}{r} 34678 \\ 34673 \\ 45780 \\ 34678 \\ 54731 \end{array} \right\}$	$\left\{ \begin{array}{r} 34978 \\ 27617 \\ 13794 \\ 21798 \\ 34763 \end{array} \right\}$
Rem.	90507	85086	117612

D

QUESTIONS

QUESTIONS TO EXERCISE THE LEARNER.

- I. What Number added to 346 will make 470? Facit 124.
- H. What Number subtracted from 946, will make the Remainder to be 78? Facit 868.
- III. I was born in the Year 1747: how old am I now, it being the Year 1774? Facit 27 Years.
- IV. Suppose, this present Year 1774, you were 19 Years old, what Year was you born in? Facit 1755.
- V. From *London* to *Aylesbury* are 33 Miles, and from *London* to *Uxbridge* are 15 Miles, how far is it from *Uxbridge* to *Aylesbury*? Facit 18 Miles.
- VI. I owe you £. 348; if now I pay you £. 279, what shall I remain indebted? Facit £. 69.
- VII. Says Dick to Harry, How old are you? Harry answers, My Brother Jack this Day is 23 Years old, and I am exactly 8 Years younger than he is; now find my Age. Facit 15 Years.
- VIII. Received this Day, of Mr. Paywell, £. 370, and paid to John Plague £. 187: what should I have remaining? Facit £. 183.
- IX. If I have £. 250 allowed to me *per annum*, and spend £. 173; what do I save a Year? Facit £. 77.
- X. A Gentleman has a yearly Income of £. 672, and he spent £. 891 last Year: what did he owe at the end of the Year? Facit £. 219.
- XI. What Number added to $14 + 16 + 29 + 18 + 39$ will make 347? Facit 231.
- XII. A Boy had 1500 Marbles; and he lost at three different Times at Play, each 175, and at another Time 150: how many has he still in Hand? Facit 825.
- XIII. I have in Cash £. 1478, and the Payments I have to make this Day are, viz. to my Book-keeper £. 25; to my Landlord £. 76; to my Coachman £. 14; to my House-keeper £. 18; to my Footman £. 8; to my two Maids, each £. 7; to John Harvey, Esq; £. 276; and to Messrs. Johnson and Co. £. 125: what will be the Neat remaining? Facit £. 922.
- XIV. A Merchant said, he would have cleared £. 1840 last Year, had he not lost by Samuel Long £. 147, by Stephen Broad £. 76, by Ship James lost, £. 364, by sundry Accounts £. 318: I ask his Neat Gain. Facit £. 935.
- XV. A Coal Merchant had bought in the Pool 1567 Chaldrons of Coals; and of them, he sold the 14th of January 209 Chaldrons, the 16th he sold 304 Chaldrons, the 20th he sold 8 Chaldrons, the 25th he sold 107 Chaldrons, the 30th he sold 109 Chaldrons, the rest he desires to be brought to his Warehouse: I demand how many Chaldrons are to be brought there? Facit 830.

XVI. Borrowed of a Friend £. 800, and paid him, the 4th of February, £. 34; the 8th of March £. 156, the 9th of April £. 370, the 10th of May £. 18, the 20th ditto £. 14, the 30th ditto £. 19, and the 6th of June £. 54: what do I remain indebted to him? Facit £. 135.

XVII. Drawn upon my Banker, viz. £. 46, payable the 14th of September; £. 54, the 8th of October; £. 34, the 19th of the same Month; £. 146, the 18th of November; and, remitted to him the 9th of September, £. 234: how much more must I send him, that he may discharge all my Draughts? Facit £. 46.

XVIII. Lent my Brother, viz. £. 35 the 4th of January, £. 24 the 3d of February, £. 49 the 8th of March, £. 56 the 11th of April, £. 68 the 2d of May, and £. 98 the 22d of May.—In Payment of all which Sums, he pays me this Day, 4th of June, £. 179: how much remains due to me? Facit £. 151.

XIX. Suppose that 2049 were given to be subtracted from $546 + 479 + 304 + 267 + 1106 + 79 + 109 + 9$, what will the Remainder be?—Facit 850.

XX. How old are you, Jack? says Dick; to which Jack answers, My Father is 55 Years old, my Mother 49, my Brother 19, my Sister 18; and the Difference between their Ages added together, and 119, is just my Age. Now, find how old I am, if you can. Facit 22 Years.

XXI. A Bankrupt owes to Edmond Price £. 146, to Henry Flin £. 84, to John Lewes £. 246, to Peter Fair £. 64, to Josiah Silver £. 28, and to sundry petty Creditors £. 149; and all his Estate, Effects, &c. are worth no more than £. 379. How much will his Creditors lose all together? Facit £. 338.

XXII. My monthly Expences, from January the 1st, to July the 31st, have been as follows: January £. 14, February £. 16, March £. 24, April £. 15, May £. 18, June £. 26, and July £. 13; and my Receipts, to the same Day, have been £. 79 only? How much did my Expences exceed my Receipts? Facit £. 47.

XXIII. Remitted to my Banker, viz. the 4th of January, £. 36, the 15th ditto £. 49, the 30th ditto £. 67, the 14th of February £. 84.—And, drawn upon him, viz. the 8th of January £. 29, the 20th ditto £. 18, the 1st of February £. 16, the 8th ditto £. 24, the 15th ditto £. 38, the 20th ditto £. 25: what is the Balance due to me? Facit £. 86.

XXIV. What is the Balance of this Account?—Facit £. 36.

Mr. JOHN PRICE Dr.				CONTRA Cr.			
1773.	4	To Half a Year's Rent	£. 45	Feb.	1	By Cash	£. 14
Jan.	8	Cash lent him	36		3	Bills receivable	29
	12	Wine, for 2 Hhds.	12		5	Cash	13
	18	Brandy, for 1 Pipe	8		19	Ditto	9

XXV. What is the Difference between $608 + 804 + 209 + 308$; and $105 + 203 + 107 + 205$? Facit 1309.

MULTIPLICATION,

Is an Addition repeated, and teacheth compendiously to find the Product of a Number given to be added to itself, as many Times as there are Units in another Number.

The Number to be added to itself, is called *Multiplicand*; the Number that expresseth how many Times the Multiplicand is to be added to itself, is called *Multiplier*; and the Quantity the Operation gives, is called *Product*, as it expresseth the Multiplicand as often as the Multiplier contains Unity.

This (X) is the Sign of Multiplication, and signifies multiplied by.

THE MULTIPLICATION TABLE.

are		are		are		are									
twice	2 = 4	4 Times	4 = 16	6 Times	6 = 36	9 Times	9 = 81								
	3 = 6		5 = 20		7 = 42		10 = 90								
	4 = 8		6 = 24		8 = 48		11 = 99								
	5 = 10		7 = 28		9 = 54		12 = 108								
	6 = 12		8 = 32		10 = 60		13 = 117								
	7 = 14		9 = 36		11 = 66										
	8 = 16		10 = 40		12 = 72		10 = 100								
	9 = 18		11 = 44		13 = 78		11 = 110								
	10 = 20		12 = 48				12 = 120								
	11 = 22		13 = 52				13 = 136								
	12 = 24														
	13 = 26														
	3 Times		3 = 9		5 Times		5 = 25	7 Times	7 = 49	10 Times	10 = 100				
4 = 12		6 = 30	8 = 56	11 = 110											
5 = 15		7 = 35	9 = 63	12 = 120											
6 = 18		8 = 40	10 = 70	13 = 136											
7 = 21		9 = 45	11 = 77												
8 = 24		10 = 50	12 = 84	11 = 121											
9 = 27		11 = 55	13 = 91	12 = 132											
10 = 30		12 = 60		13 = 143											
11 = 33		13 = 65													
12 = 36															
13 = 39															
4 Times		4 = 16	6 Times	6 = 24		8 Times	8 = 64		11 Times		11 = 121				
		5 = 20		7 = 35			9 = 72				12 = 144				
	6 = 24	8 = 40		10 = 80	13 = 156										
	7 = 28	9 = 45		11 = 88											
	8 = 32	10 = 50		12 = 96	13 = 169										
	9 = 36	11 = 55													
	10 = 40	12 = 60													
	11 = 44	13 = 65													
	12 = 48														
	13 = 52														
	5 Times	5 = 25		7 Times	7 = 35		9 Times	9 = 81		12 Times	12 = 144				
		6 = 30			8 = 40			10 = 90			13 = 156				
		7 = 35			9 = 45			11 = 99							
8 = 40		10 = 50	12 = 108												
9 = 45		11 = 55	13 = 117												
10 = 50		12 = 60													
11 = 55		13 = 65													
12 = 60															
13 = 65															
6 Times		6 = 24	8 Times		8 = 32	10 Times		10 = 60	13 Times		13 = 169				
		7 = 28			9 = 36			11 = 66							
		8 = 32			10 = 40			12 = 72							
		9 = 36			11 = 44			13 = 78							
	10 = 40	12 = 48													
	11 = 44	13 = 52													
	12 = 48														
	13 = 52														
	7 Times	7 = 28		9 Times	9 = 36		11 Times	11 = 66		14 Times	14 = 196				
		8 = 32			10 = 40			12 = 72							
		9 = 36			11 = 44			13 = 78							
		10 = 40			12 = 48										
		11 = 44			13 = 52										
12 = 48															
13 = 52															
8 Times		8 = 32	10 Times		10 = 40	12 Times		12 = 72	15 Times		15 = 225				
		9 = 36			11 = 44			13 = 78							
		10 = 40			12 = 48										
		11 = 44			13 = 52										
		12 = 48													
		13 = 52													
	9 Times	9 = 36		11 Times	11 = 44		13 Times	13 = 78		16 Times	16 = 256				
		10 = 40			12 = 48										
		11 = 44			13 = 52										
		12 = 48													
		13 = 52													
		10 Times			10 = 40			12 Times			12 = 48	14 Times	14 = 78	17 Times	17 = 289
					11 = 44						13 = 52				
12 = 48															
13 = 52															
11 Times			11 = 44		13 Times	13 = 52			15 Times		15 = 78		18 Times		18 = 324
			12 = 48			14 = 56									
			13 = 52												
			12 Times			12 = 48					14 Times				14 = 56
	13 = 52			15 = 60											
				16 = 64											
				17 = 68											
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	294 = 1176														
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	300 = 1200														
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	313 = 1252														
	314 = 1256														
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	316 = 1264														
	317 = 1268														
	318 = 1272														
	319 = 1276														
	320 = 1280														
	321 = 1284														
	322 = 1288														
	323 = 1292														
	32														

Observe that 3 Times 2, is the same as twice (or two Times) 3.—
4 Times 3 is the same as 3 Times 4; and so on.

Case

CASE I. The Multiplier not exceeding 13.

RULE. Begin to multiply by the first Figure, in the Units Place, of the Multiplicand. Set down the Units, and carry the Tens in Mind 'till you have multiplied the next Figure in the Multiplicand, to the Product of which add the Tens you had kept in Mind. Proceed thus successively for each Figure of the Multiplicand.

For PROOF. Take the Half of the Multiplicand, and double the Multiplier; or, double the Multiplicand, and take the Half of the Multiplier. Afterwards, make another Multiplication, and if the Product of this is the same as that of the first, the Operation is right.—If there is one Half ($\frac{1}{2}$) in the Multiplicand, take the Half of the Multiplier, which Half add to the other Product; and, on the contrary, if the Half stands in the Multiplier, take the Half of the Multiplicand, the Sum of which Half add in the same Manner.

N. B. Multiplication is also proved by dividing the Product by either the Multiplier or the Multiplicand; but as this Proof can be used only after having gone through Division, so, for the present, I have adopted the other Method, which will prove more useful to a Scholar than the erroneous Proof by 9, since he still improves in Multiplication by it.

EXAMPLE.

Bought 346 Hhds. of Port Wine, at £. 6 per Hhd.: how much will the Whole come to? Facit £. 2076.

346 Multiplicand.
6 Multiplier.

2076 Product.

ILLUSTRATION.

Having written down the Quantity bought to stand as Multiplier, I set down the Price under it for Multiplier, and then say thus: 6 Times 6 are 36: therefore I write 6 in the Product under the Multiplier 6, and carry 3 in Mind for the three Tens (which 3 I am to join to the next Product).

6 Times 4 are 24 + 3, that I carry, = 27: therefore, I write 7 in the Product, before the 6, and carry 2 in Mind.

Finally, 3 Times 6 are 18 + 2, that I carry = 20, which I at once write in the Product before the 76, it being the Product of the last Figure in the Multiplicand.

Thus, I find that the Product of 346 multiplied by 6 = 2076; of which to make

7

THE

THE PROOF

173 new Multiplicand.

12 new Multiplier.

2076 same Product.

I take the Half of 346, saying thus: the Half of 3 is 1, to write down, and 1 over; which being worth 10 of the next Units, the Half of 14 is 7, to write down; and the Half of 6 is 3. Thus, I have 173 for new Multiplicand. Then, doubling the Multiplier 6, I have 12 for new Multiplier. And making another Multiplication, I find the same Product 2076, thus:

$12 \times 3 = 36$: therefore, I write 6 in the Product, and carry 3 in Mind.

$7 \times 12 = 84 + 3$, that I carry = 87: therefore, I write 7 in the Product, and carry 8.

$1 \times 12 = 12 + 8$, that I carry, = 20, which I write down it being the Product of the last Figure.

What is the Product of 749, multiplied by 4? Facit 2996.

$$\begin{array}{r} 749 \\ 4 \\ \hline 2996 \end{array}$$

Proof

$$\left\{ \begin{array}{l} \text{The Half of } 749 = 374 + \frac{1}{2} \\ \text{The double of } 4 = 8 \end{array} \right.$$

2992

For $\frac{1}{2}$ in the Multiplier, take the $\frac{1}{2}$ of the Multiplier, and add it to the Product.

2996

What do 5406 come to, multiplied by 9? Facit 48654.

$$\begin{array}{r} 5406 \\ 9 \\ \hline 48654 \end{array}$$

Proof

$$\left\{ \begin{array}{l} \text{The double of } 5406 = \dots 10812 \\ \text{The Half of } 9 = \dots 4 + \frac{1}{2} \end{array} \right.$$

48654

For $\frac{1}{2}$ in the Multiplier, take the Half of the Multiplicand, and add it to the Product

43248

5406

48654

OTHER EXAMPLES.

$$\begin{array}{r} 57645 \\ 3 \\ \hline 172935 \end{array}$$

$$\begin{array}{r} 47004 \\ 4 \\ \hline 188016 \end{array}$$

$$\begin{array}{r} 57684 \\ 5 \\ \hline 288420 \end{array}$$

$$\begin{array}{r} 34709 \\ 6 \\ \hline 208254 \end{array}$$

49708

IN WHOLE NUMBERS.

23

49708 7	67904 8	56909 9	30047 11
347956	543232	512181	330517
97645 12	84767 11	67547 12	38479 13
1171740	932437	810564	500227

CASE II. The Multiplier being above 10, and less than 20.

RULE. Multiply by the Units in the Multiplier, and to the Product add the back Figure; observing that what you carry at last, and the last Figure of the Multiplicand joined together must be prefixed to the Product.

PROOF. As in CASE I.

EXAMPLE.

Multiply 546 by 13. Facit 7098.
546 Multiplicand.
13 Multiplier.
7098 Product.

ILLUSTRATION.

1st, $6 \times 3 = 18$. Therefore I write down 8 under the Multiplier 3, and carry 1.

2dly, $3 \times 4 = 12 + 1$, that I carry $= 13 + 6$, back Figure to 4 = 19: so, I write down 9 before the 8, and carry 1.

3dly, $3 \times 5 = 15 + 1$, that I carry $= 16 + 4$, back Figure to 5 = 20: so, I write down 0 before 98, and carry 2.

4thly, 2, that I carry, and 5 last Figure = 7, which I prefix to 098.

Thus, I find the Total Product of 546 multiplied by 13 to be 7098; of which to make

THE PROOF

I double the Multiplicand 546 = 1092
And take the Half of the Multiplier 13 = 6 + $\frac{1}{2}$

For $\frac{1}{2}$ in the Multiplier take the Half of the Multiplicand } 652
1092 = 546

Same Product = 7098

OTHER

11

OTHER EXAMPLES.

$$\begin{array}{r} 684794 \\ 14 \end{array}$$

$$\begin{array}{r} 9587116 \\ 18 \end{array}$$

$$\begin{array}{r} 679478 \\ 18 \end{array}$$

$$\begin{array}{r} 12230604 \end{array}$$

$$\begin{array}{r} 989407 \\ 15 \end{array}$$

$$\begin{array}{r} 14706105 \\ 18 \end{array}$$

$$\begin{array}{r} 579948 \\ 18 \end{array}$$

$$\begin{array}{r} 10260864 \end{array}$$

$$\begin{array}{r} 400497 \\ 16 \end{array}$$

$$\begin{array}{r} 6407952 \\ 19 \end{array}$$

$$\begin{array}{r} 679407 \\ 19 \end{array}$$

$$\begin{array}{r} 12908733 \end{array}$$

$$\begin{array}{r} 579790 \\ 17 \end{array}$$

$$\begin{array}{r} 9703430 \\ 19 \end{array}$$

$$\begin{array}{r} 576794 \\ 19 \end{array}$$

$$\begin{array}{r} 10957376 \end{array}$$

CASE III. The Multiplier being above 20, i. e. consisting of several Figures.

RULE. Begin to multiply by the Units of the Multiplier (as by CASE I). Afterwards, multiply by the Tens of the Multiplier; and thus proceed (always from Right to Left) 'till you have worked with all the Figures of the Multiplier. But, observe that when you multiply by Tens, you are to begin to set down their Product at the Row of Tens only; when by Hundreds, begin to set down their Product at the Row of Hundreds, &c.—The several Products, added up together, will give the Total Product required.

PROOF. As in CASE I.

EXAMPLE.

$$\begin{array}{r} \text{Multiply} \quad - \quad - \quad - \quad 948 \\ \text{by} \quad - \quad - \quad - \quad 76 \end{array}$$

$$\begin{array}{r} 5688 \\ 6636 \end{array}$$

$$\begin{array}{r} \text{Product} \quad - \quad - \quad - \quad 72048 \end{array}$$

ILLUSTRATION.

Here, as the Multiplier is above 19, I begin to Multiply 948 by 6, Units in the Multiplier, thus: 1st, $6 \times 8 = 48$, so, I write down 8 under 6 (Units in the Multiplier) and carry 4. 2dly, $6 \times 4 = 24 + 4$, that I carry, = 28; so, I write down 8 before 8 and carry 2. 3dly, $6 \times 9 = 54 + 2$, that I carry, = 56, to write down in full before 88, it being the last Product of Units; thus, I find the Product 5688.

That done, I proceed to the Tens, thus: 1st, $7 \times 8 = 56$; so, I write down 6 beginning to set down under the Column of Tens, because it is by Tens that I now multiply (had this Multiplier been Hundreds

IN WHOLE NUMBERS. 25

Hundreds, I should have begun to set the Product under Hundreds only, &c), and carry 5. 2dly, $7 \times 4 = 28 + 5$, that I carry, $= 33$; so, I write down 3 before 6, and carry 3. 3dly, $7 \times 9 = 63 + 3$, that I carry $= 66$, to write down in full before 36, it being the last Product of Tens; thus, I find the Product 6636 Tens, to be considered as if written thus, 66360.

Now, having no other Figure in the Multiplier to multiply by, I have nothing else to do but to add up the Products together, which give me the Total 72048, Product required; of which to make

THE PROOF

I take the Half of 948 $= 474$ or I double 948 $= 1896$
and double 76 $= 152$ and take the Half of 76 $= 38$

Then multiplying 948 Then multiplying 15168
as before 7110 as before 5688

I find the same Product 72048 I find the same Product 72048

N. B. If it so happens that the Multiplicand has less Figures than the Multiplier, then, considering the Multiplicand as Multiplier, you may multiply by the Figures in the Multiplicand instead of doing it by those in the Multiplier, and yet without altering their Order, as follows:

Multiply - - 484 { Here I 1st multiply the Figures that stand
by - 484967 underneath (the Multiplier) 484967 by
1939868 the Units 4 that stand at Top, which
3879736 give me 1939868. 2dly, by the Tens 8,
1939868 which give 3879736. 3dly, by the Hun-
dreds 4, which give 1939868.—And, add-
ing up the three Sums together I have the
Product 234724028 Product required,

OTHER EXAMPLES.

Multiply . 35849 PROOF. The Half of 35849 $= 17924 \frac{1}{2}$
by 2419 The double of 2419 $= 4838$

681131 143392
143396 53772
71698 143392
71696
Product 86718731 $\frac{1}{2}$ at Top $= \frac{1}{2}$ of the Bottom 2419
86718731
Multiply

MULTIPLICATION

Multiply 504079
by 5987

3528553
4032632
4536711
2520395

3017920973

54938
947

52026286

9457
5476

51786532

The Double of 504079 = 1008158
The Half of 5987 = 2993 + $\frac{1}{2}$

3024474
9073422
9073422
2016316
504079

$\frac{1}{2}$ at Bottom = $\frac{1}{2}$ at Top

PROOF. 3017920973

64983
687

44643321

5785
749

4332965

8479
876

7427604

2710432
375

1016412000

Note I. If the Multiplier be a Repetend of the same Figure, multiply by one of the repeating Figures; write down the Figures of that Product in as many Products as the Multiplier repeats the same Figure; then add the Sums together, and the Total will quote the Product required.

EXAMPLES.

Multiply 3496 by 222

3496
2
6992
6992
6992
776112

Multiply 5749 by 3333

3
17247
17247
17247
17247
19161417

Note II. When the Repeating Figure is a high Digit, write down the Figures of the Multiplicand in as many Products as the Multiplier repeats the same Figure; add the Sums together, multiply the Total by the Repetend; and the Product will be that required.

EXAMPLES.

EXAMPLES.

Multiply 549 by 777

$$\begin{array}{r} 549 \\ 549 \\ \hline \text{Total} - - 60939 \\ 7 \\ \hline \text{Product} - 426573 \end{array}$$

Multiply 8476 by 8888

$$\begin{array}{r} 8476 \\ 8476 \\ 8476 \\ \hline 9416836 \\ 8 \\ \hline 75334688 \end{array}$$

There is another Way, for finding the Product of any Series of repeating Figures, a great deal more Expedition than the above: but as it is performed by Division, the Rule for it will properly come after the 1st Case in Division.

CASE IV. Cyphers being placed between the Significant Figures in the Multiplier.

RULE. Since Nothing multiplied by Nothing can produce Nothing, omit the Cyphers; but, as by each Cypher the Figure that precedes is increased of Ten, so you must take Care that the next Figure in the Product be put one Place more to the Left Hand, that is, under the Figure you multiply by.

For PROOF. As in CASE I.

EXAMPLE.

Multiply 35849 by 2409

$$\begin{array}{r} 35849 \\ 2409 \\ \hline 322641 \\ 143396 \\ 71698 \\ \hline 86360241 \end{array}$$

PROOF.

$$\begin{array}{r} \text{The Double of } 35849 = 71698 \\ \text{The Half of } 2409 = 1209 \frac{1}{2} \\ \hline 286792 \\ 860376 \\ \hline \frac{1}{2} = \dots - 35849 \\ \hline 86360241 \end{array}$$

ILLUSTRATION.

Multiplying 35849 by 9 Units, (as in the last Cases) I find 322641. Now, as the second Figure in the Multiplier is 0, I omit it, and proceed to the Hundreds of the Multiplier, and multiplying the Multiplicand 35849 by 4, I begin to set down the Product under the Hundreds place only; and thus find 143396 Hundreds, to be considered therefore as if written thus, 14339600.— Then multiplying the Multiplicand 35849 by the last Figure in the

MULTIPLICATION

the Multiplier, viz. 2 (Thousands), I find 71698 Thousands, to be considered therefore as if written thus, 71698000.—Finally, adding up the three Products together, I find the Total Product to be 86360241, which I prove as in the other Cases.

OTHER EXAMPLES.

645304	574008	
27009	409006	
5807736	3444048	
4517128	5166072	
1290608	2296032	
17429015736	234772716048	
571204	7104325	5271094
27009	57020	590030
15427648836	405088611500	3110103592820

CASE V. The Multiplicand or Multiplier ending with Cyphers.

RULE. Omit the final Cyphers, and multiply only by the Significant Figures; but, to the Total Product remember to annex as many Cyphers as there are in both Multiplicand and Multiplier.

PROOF. As in CASE I.

EXAMPLE.

Multiply 390 by 400

39|0
4|00

Product 156,000

PROOF.

The Double of 390 = 780

The Half of 400 = 200

156,000

ILLUSTRATION.

In the above Example, cutting off the final Cyphers, it remains only 39 to be multiplied by 4, which produce 156 to set down in the Product. Then, as there are 1 Cypher in the Multiplicand and 2 in the Multiplier, so, I annex 3 Cyphers to 156; and thus, find that the Product of 390 multiplied by 400 amounts to 156000, which I prove as in the other Cases.

OTHER

OTHER EXAMPLES.

$\begin{array}{r} 456 0 \\ 309 0 \\ \hline 4104 \\ 1368 \\ \hline 140904,00 \end{array}$	$\begin{array}{r} 407 0 \\ 31 00 \\ \hline 407 \\ 1221 \\ \hline 12617,000 \end{array}$	$\begin{array}{r} 4869 \\ 6809 \\ \hline 38952 \\ 29214 \\ \hline 331092,00 \end{array}$
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Note I. When you are to multiply by 1, *the Answer* will be the same as *the Multiplicand* itself is. If you are to multiply by 10, there is no Occasion to do any Thing else but to add 1 Cypher to the Multiplicand; if by 100, add 2 Cyphers, if by 1000, add 3 Cyphers; and thus for as many Cyphers as you please.

EXAMPLES.

Multiply 344 by 1, Answer the same, 344.
 by 10, add 1 Cypher. Facit 3440.
 by 100, add 2 Cyphers. Facit 34400.
 by 1000, add 3 Cyphers. Facit 344000.
 by 10000, add 4 Cyphers. Facit 3440000.

Note II. If the Multiplier be any Number near 10, 100, 1000, 10000, &c. increase the Multiplicand by as many Cyphers as there are Figures in the Multiplier, and subtract the Multiplicand from itself (thus increased) as often as the Multiplier wants Units of that by which the Multiplicand was increased.

EXAMPLES.

Multiply 4749 by 98 98 is 2 short of 100, therefore From 4749,00 Subtract 9498 = 4749 × 2 Product 465402	Multiply 3547 by 9997 9997 is 3 short of 10000, therefore From 3547,0000 Subtract 10641 = 3547 × 3 Product 35459359
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CASE VI. If the Multiplier or Multiplicand can be divided into two or several common Multiples.

RULE. Consider which two or three Numbers multiplying one another will give exactly either the Multiplicand or the Multiplier; then multiply the given Sum (which does not form common Multiples) by one of the common Multiples: this Product, multiply afterwards by the next common Multiple: and so on.

PROOF. Work by the common Way; or, multiply reversely by the common Multiple, which, in the first Operation, was the last;

30 MULTIPLICATION

last; then by that common Multiple which was next to the last; and so on.

EXAMPLES.

I. What is the Product of 459 multiplied by 63? Facit 28917.

$\begin{array}{r} \text{As } 7 \times 9 \\ \text{or} \\ 9 \times 7 \end{array}$	$\left. \begin{array}{l} \\ \\ \end{array} \right\} = 63, \text{ so,}$	$\begin{array}{r} 459 \\ 7 \\ \hline 3213 \\ 9 \\ \hline 28917 \end{array}$	$\begin{array}{r} \text{Product of } 7 \\ 9 \\ \hline \text{Product of } 63 \end{array}$	or	$\begin{array}{r} 459 \\ 9 \\ \hline 4131 \\ 7 \\ \hline 28917 \end{array}$	$\begin{array}{r} \text{Product of } 9 \\ 7 \\ \hline \text{Product of } 63 \end{array}$
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ILLUSTRATION.

Here I consider which Numbers being multiplied together would make 63 (*Multiplier*; common Multiples could not be found in the *Multiplicand* 459), and find that 7 times 9 make 63, as do likewise 9 times 7. Therefore, I multiply 459 by 7 and get 3213, which multiplied by 9 give 28917 Product required. Or else, I multiply 459 first by 9 and get 4131, which multiplied by 7 give the same Product 28917. And these two Ways may serve for Proof to one another.

II. What is the Product of 54 multiplied by 346? Facit 18684.

$\begin{array}{r} \text{As } 6 \times 9 \\ \text{or} \\ 9 \times 6 \end{array}$	$\left. \begin{array}{l} \\ \\ \end{array} \right\} = 54, \text{ so,}$	$\begin{array}{r} 346 \\ 6 \\ \hline 2076 \\ 9 \\ \hline 18684 \end{array}$	$\begin{array}{r} \text{Product of } 6 \\ 9 \\ \hline \text{Product of } 54 \end{array}$	or	$\begin{array}{r} 346 \\ 9 \\ \hline 3114 \\ 6 \\ \hline 18684 \end{array}$	$\begin{array}{r} \text{Product of } 9 \\ 6 \\ \hline \text{Product of } 54 \end{array}$
---	--	---	--	-------------	---	--

ILLUSTRATION.

Here, as I could not find common Multiples in the *Multiplier* 346, so, I take the *Multiplicand*, and consider as above directed; which Numbers being multiplied together will make 54; finding that 6 Times 9 or 9 Times 6 make 54, I conclude that, to get the Product required, I may multiply either by 6 and its Product by 9, or first by 9 and then its Product by 6.

N. B. The Method taught by this Case is at present of very little Service; but it serves as an Introduction to the same Case in Division, where it will prove very useful, as likewise in Multiplication and Division of several Denominations.

Note I. When either the *Multiplier* or the *Multiplicand* can be parted into Periods, which are Multiples of one another (one Number

IN WHOLE NUMBERS. 31

Number is said to be the Multiple of another, when it contains a certain Number of Times without any Remainder), the Operation may be contracted in the following Manner :

$$\begin{array}{r}
 5697487 \\
 96488 \\
 \hline
 45579896 = 5697487 \times 8 \text{ for } \dots\dots\dots 8 \\
 273479376 = 45579896 \times 60 \text{ because } 8 \times 60 = 480 \\
 546958752 = 273479376 \times 200 \text{ because } 480 \times 2 = 96000 \\
 \hline
 57476248856 = 5697487 \times \dots\dots\dots 96488 \\
 \hline
 \end{array}$$

Or, in a reversed Order, thus :

$$\begin{array}{r}
 5742135 \\
 52575 \\
 \hline
 28710675 = 5742135 \times 50000 \text{ for } 50000 \\
 143553375 = 28710675 \times 500 \text{ for } 2500 \\
 430660125 = 143553375 \times 3 \text{ for } 75 \\
 \hline
 301892747625 = 5742135 \times \dots\dots\dots 52575 \\
 \hline
 \end{array}$$

Note II. When the Multiplier and Multiplicand consist of a great Number, wherein common Multiples can not be found, the Answer may still be gotten by multiplying by Parts, according to this Rule: multiply by as many Tens as the Multiplier consists of Places, save one, the last Product by the first Figure on the Left Hand, the next in order by the succeeding Place, &c.—The Sum of the Products of these Places will give that required.

EXAMPLE.

What is the Product of 436843246 multiplied by 578? Facit 252495396188.

$$\begin{array}{r}
 \text{For } 8 \times 436843246 \\
 \hline
 10
 \end{array}$$

$$\begin{array}{r}
 \text{For } 70. 7 \times 4368432460 \\
 \hline
 10
 \end{array}$$

$$\begin{array}{r}
 43684324600 \\
 \hline
 5
 \end{array}$$

$$218421623000 = \text{Product of } 500$$

$$30579027220 = \text{Product of } 70$$

$$3494745968 = \text{Product of } 8$$

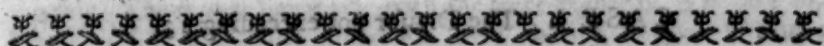
$$252495396188 = \text{Product of } 578$$

QUESTIONS

QUESTIONS TO EXERCISE THE LEARNER.

- I. How many Guineas come 49 Months Salary to, at 3 Guineas a Month? Facit 147 Guineas.
- II. In 45 Chaldrons of Coals, how many Bushels, there being 36 Bushels in a Chaldron? Facit 1620.
- III. Square 57; that is, multiply 57 by itself. Facit 3249.
- IV. In £.756, how many Pence, there being 240 Pence in a £? Facit 181440.
- V. In £.84, how many Farthings; there being 960 Farthings in a £? Facit 80640.
- VI. Bought 346 Lottery Tickets, at £.18 each: what do they come to in all? Facit £.6228.
- VII. What Sum must be divided amongst 24 Persons, so that each may receive £.68? Facit £.1632.
- VIII. Bought 56 Pieces of Cloth, each containing 45 Yards, how many Yards is it in all? Facit 2520.
- IX. Multiply 9708 by 100. Facit 970800.
- X. Multiply 57604 by 1200. Facit 69124800.
- XI. Multiply 8516 by 76002. Facit 647233032.
- XII. Multiply 90409 by 760095. Facit 7151733855.
- XIII. Multiply 16515 by 14313. Facit 236412225.
- XIV. Multiply 5344 by 12000. Facit 64128000.
- XV. Multiply 8406 by 4078. Facit 34279668.
- XVI. Cube 435; that is, multiply that Number by itself, and the Product of this Multiplication multiply again by 435. Facit 82312875.

DIVISION.



DIVISION

Is a Subtraction repeated, and teacheth compendiously to find how often one Number is contained in a greater, or to divide a great Number in what Parts you please.

The Number given to be divided, is called *Dividend*: the Number given to divide by, is called *Divisor*; and the Number which, when the Operation is done, expresseth how many Times the Dividend comprises or includes the Value of the Divisor, is called *Quotient*.

This ($\div$) is the Sign of Division, and signifies *divided by*.

The Multiplication Table being reversed, will, in the following Manner, give

THE DIVISION TABLE.

In.	Anf.	In.	Anf.	In.	Anf.	In.	Anf.
2	1	5	1	8	1	12	1
4	2	10	2	16	2	24	2
6	3	15	3	24	3	36	3
8	4	20	4	32	4	48	4
10	5	25	5	40	5	60	5
12	6	30	6	48	6	72	6
14	7	35	7	56	7	84	7
16	8	40	8	64	8	96	8
18	9	45	9	72	9	108	9
3	1	6	1	9	1	13	1
6	2	12	2	18	2	26	2
9	3	18	3	27	3	39	3
12	4	24	4	36	4	52	4
15	5	30	5	45	5	65	5
18	6	36	6	54	6	78	6
21	7	42	7	63	7	91	7
24	8	48	8	72	8	104	8
27	9	54	9	81	9	117	9
4	1	7	1	11	1	Observe that in 2, how many Times 4, is not the same Thing as in 4 how many Times 2? &c.	
8	2	14	2	22	2		
12	3	21	3	33	3		
16	4	28	4	44	4		
20	5	35	5	55	5		
24	6	42	6	66	6		
28	7	49	7	77	7		
32	8	56	8	88	8		
36	9	63	9	99	9		

F

CASE

CASE I. The Divisor not exceeding 13.

RULE. Write down the Divisor on the Left Hand of the Dividend, which separate by a Line. Then, consider if the first Figure of the Dividend is equal to, or more or less than, the Divisor; if equal, write down 1 in the Quotient; if more, seek how many Times the Divisor is contained in that first Figure, and set down the Number in the Quotient: If less, seek how many Times the Divisor is contained in the two first Figures (which you will easily discover, if you know perfectly the Division Table), and set down the Number in the Quotient.

If any Thing remains from the first, or any other Figure in the Dividend, it is as many Tens to carry to the next.—If the Divisor is not once contained in any Figure of the Dividend, increase the Quotient with a Cypher; then see how many Times it is contained in that and the next Figure joined together.—And, when some Thing remains from the last Figure, express it in a Fraction, by writing that Remainder on the Side of the Quotient, for the Numerator of the Fraction, and putting the Divisor under, for the Denominator.

For **PROOF.** Multiply the Quotient by the Divisor, taking, in the first Product, the Parts remaining or Numerator of the remaining Fraction (if any); and if the Product comes the same with the Dividend, the Operation is right.

EXAMPLE.

Divide 5894678 by 8. Facit $736834 + \frac{6}{8}$

Divisor Dividend Quotient

8) 5894678 (736834 + 6 Numerator

8 Denominator

736834

8 + 6

5894678 PROOF.

The 1st Figure is 8 because $32 + 6 = 38$.

ILLUSTRATION.

Here the Divisor being 8, and the first Figure in the Dividend being less, I work with the two first Figures, saying thus:

1st, In 58, how many Times 8? And, finding that it goes 7 Times and 2 over, I set down 7 in the Quotient, and point off the 58, to shew that I have done with them.

2dly, As the two that are over are two Tens of the next Figure, or 20, so, with the next Figure in the Dividend 9, it is 29. Therefore, I say; in 29, how many Times 8? And, finding it goes 3 Times and 5 over, I set down 3 in the Quotient.

3dly, The 5 over being 50, with the next Figure 4, it is 54; so, I say; in 54, how many Times 8? And, finding it goes 6 Times and 6 over, I set down 6 in the Quotient.

4thly,

4thly, The 6 over being 60, with the next Figure 6, it is 66; so, I say; in 66, how many Times 8? And, finding it goes 8 Times and 2 over, I set down 8 in the Quotient.

5thly, The 2 over being 20, with the next Figure 7, it is 27; so, I say; in 27, how many Times 8? And, finding it goes 3 Times and 3 over, I set down 3 in the Quotient.

6thly, The 3 over being 30, with the next Figure 8, it is 38; so, I say; in 38, how many Times 8? And, finding it goes 4 Times and 6 over, I set down 4 in the Quotient.

7thly, As there is no other Figure in the Dividend; so, I set down the 6 over, prefixing to it the Sign of *Plus* (+); then I set down under that 6 the Divisor 8. Thus I have the Remainder expressed fractionally thus, $\frac{6}{8}$, which means, that besides the Quotient 736834 there are 6 Parts of 8 over, in the present Division.

To prove this Operation, I multiply the Quotient 736834 by the Divisor 8, taking, in the first Product, the Remainder 6. And thus I find 5894678; which Sum being the same as the Dividend, I conclude that the Operation is right.

N. B. In all Questions of this Case, the Quotient is generally set down under the Dividend, which Method is more according to Practice; and then, there is no Occasion for pointing off the Figures in the Dividend; as

$$\begin{array}{r} 8) 5894678 \\ 736834 + \frac{6}{8} \end{array}$$

OTHER EXAMPLES.

$$\begin{array}{r} 2) 184785 \\ \text{Quotient } 92392 + \frac{1}{2} \end{array}$$

$$\begin{array}{r} 3) 29468 \\ 9822 + \frac{2}{3} \end{array}$$

$$\begin{array}{r} 4) 386784 \\ 96696 \end{array}$$

$$\begin{array}{r} 5) 46789 \\ 9357 + \frac{4}{5} \end{array}$$

$$\begin{array}{r} 6) 457845 \\ 76307 + \frac{3}{6} \end{array}$$

$$\begin{array}{r} 7) 648785 \\ 92683 + \frac{4}{7} \end{array}$$

$$\begin{array}{r} 9) 89786 \\ 9976 + \frac{2}{9} \end{array}$$

$$\begin{array}{r} 11) 54878 \\ 4988 + \frac{10}{11} \end{array}$$

$$\begin{array}{r} 11) 87904 \\ 7991 + \frac{3}{11} \end{array}$$

$$\begin{array}{r} 12) 57684 \\ 4807 \end{array}$$

$$\begin{array}{r} 12) 75879 \\ 6323 + \frac{3}{12} \end{array}$$

$$\begin{array}{r} 13) 84767 \\ 6520 + \frac{7}{13} \end{array}$$

A SUPPLEMENT TO CONTRACTIONS IN MULTIPLICATION.

1st, The shortest Way to multiply by Repetends, is this: annex to the Multiplicand as many Cyphers as the Multiplier repeats the same Figure; multiply by one of the Repeated Figures; the Product divide by 9, neglecting the Fraction remaining at last; from the

F 2

Quotient

Quotient of which, subtract the Figures (of the Quotient), Left-Hand, exceeding the Number of Cyphers annexed.

EXAMPLE.

Multiply 5494 by 888. Facit 4878672 Or, thus:

5494,000

annexing the 5494

Cyphers to the 8 000

9) 43952000

9) 43952 000

Quotient 4883555 + 5, which
Subtract 4883 don't mind.

Quotient 4883,555 +
Subtract 4883

Product 4878672

Product 4878672

2dly, Another short Method of Multiplication, when the Multiplier is any even Part of 100, 1000, &c. is thus by Division: If it is an even Part of 100, annex two Cyphers to the Multiplicand; if it is an even Part of 1000, annex three Cyphers; then divide by that Digit which is the even Part.

EXAMPLES.

Multiply 8497 by 125

Multiply 333 $\frac{1}{3}$ by 4789

125 is $\frac{1}{8}$ of 1000 wherefore

333 $\frac{1}{3}$ is $\frac{1}{3}$ of 1000, wherefore

8) 8497,000

3) 4789,000

Product 1062 125

Product 1596 333 + $\frac{1}{3}$

Here may be observed, that, to multiply by a Whole Number and a Fraction, you must, find first the Product of the Whole Numbers, then take Part or Parts of the Multiplicand for the Fraction, as has been seen in the Proof of Multiplication, when $\frac{1}{2}$ has occurred.

EXAMPLES.

Multiply 246 by $4\frac{1}{3}$

5676

5784

4

$4\frac{2}{3}$

$3\frac{3}{4}$

Note, $\frac{3}{4} = \frac{1}{4}$
of the Pro-
duct of 3.

5) 246 = 984
49 $\frac{1}{3}$

22704

4) 17352

1892

4338

1892

21690

Product 1033 $\frac{1}{3}$

26488

CASE

CASE II. The Divisor consisting of several Figures.

RULES. Write down (as in Case I.) the Divisor on the Left-Hand of the Dividend; and, on the Right-Hand of the said Dividend, place each Figure of the Quotient, which to find:

See how many Figures the Divisor has, and point off as many Figures in the Dividend. Consider afterwards, if the Value of those Figures marked (which call a *Dividual*) is equal to, greater or less than, that of the Divisor. If equal, the Quotient will be 1: if greater, seek how many Times the first Figure of the Divisor is contained in the first Figure of the Dividend: if less, mark another Figure in the Dividend; and then, ask how many Times the first Figure of the Divisor is contained in the two first Figures of the Dividend: But observe, that no more than 9 can be admitted at once to the Quotient.

Multiply by this Digit (put in the Quotient) each Figure of the Divisor, and write the Product under the Dividual, beginning from the Figure marked Right-hand; and, when you have found the whole Product, subtract it from the Dividual: But remember, that the Remainder must not be greater than the Divisor, or equal to it; or else you must add another Unit to the Figure you have written in the Quotient: Observe, likewise, that the Subtrahend, i. e. the Product (of the Multiplication of the Divisor by the Quotient) must not be greater than the Dividual; or else, you must lessen the Figure put in the Quotient of an Unit, or two if required; and then begin again as before.

To the Remainder annex the next Figure, which is unmarked in the Dividend, for a new Dividual, with which work as before; and if the Divisor is not once contained in any Dividual, increase the Quotient with a Cypher, before any new Figure of the Dividend is taken down to the Right of the Dividual.

If any Thing remains after all the Places are taken down from the Dividend, write down that Rest inside of the Quotient, and the Divisor under it in Form of a Fraction, as in CASE I.

PROOF. As is CASE I.

What is the Quotient of 84714 divided by 453? Facit $187 + \frac{3}{453}$.

453)	84714	(187 + $\frac{3}{453}$.	453
Prod. of 1	453	Subtract.	187 + 3
	394	1 new Dividual.	3174 because $3 \times 7 = 21 + 3 = 24$
Prod. of 8	3624	Subtract.	8154
	3174	new Divid.	84714 PROOF.
Prod. of 7	3171	Subtract.	
Remainder	.	3	

ILLUSTRATION.

ILLUSTRATION.

1st, In the above Question, the Divisor having 3 Figures, I point off the third Figure of the Dividend; and as 847 is greater than the Divisor 453, I point off no other Figure in the Dividend; and 847 is the present Dividual. Therefore I seek how many Times 4, first Figure in the Divisor, can be contained in 8 first Figure in the Dividual. It seems that it could be twice (2×4 making 8); but if by these 2 I should multiply the Divisor 453, I would find the Product 906, which I could not subtract from 847. Therefore I write 1 only in the Quotient.

Then, multiplying the Divisor by the Quotient 1, it gives the same 453, which Product I set down under the Dividual 847; and, by Subtraction, I find it remains 394.

2dly, To the Remainder 394, I join the next Figure of the Dividend 1, which Figure there I point off; thus the present Dividual is 3941. And as this Dividual has one Figure more than the Divisor 453; so, taking the two first Figures, I say: in 39 how many Times 4? It seems it could go 9 Times (9×4 making 36): But if by these 9 I should multiply the Divisor 453, I would find the Product 4077, which I could not subtract from 3941. Therefore I write 8 only in the Quotient.

Then, multiplying the Divisor 453 by the Quotient 8, it gives 3624, which Product I set down under the Dividual 3941; and, by Subtraction, I find it remains 317.

3dly, To the Remainder 317, I bring down and join the next Figure in the Dividend 4, which Figure there I point off; thus the present Dividual is 3174. And as this Dividual contains one Figure more than the Divisor, so, making Use of the two first Figures, I say; in 31, how many Times 4? Trying the Digit 7, I find it can go 7, because it will not produce more than the Dividend is; therefore I write 7 in the Quotient.

Then, multiplying the Divisor 453 by the Quotient 7, it gives 3171, which Product I set down under the Dividual 3174; and, by Subtraction, I find it remains 3; which, as there is no other Figure to be brought down from the Dividend, is the last Remainder.

Thus, I find that 84714, divided by 453 give the Quotient 187, and 3 Parts of 453 besides; so, to express that Remainder fractionally, I place, inside of 187, 3 for the Numerator and 453 under it for Denominator.

To prove the Operation, I multiply the Divisor 453 by the Quotient 187, taking in the first Product the Remainder 3; and the total Product comes to 84714, same Sum as the given Dividend.

OTHER

OTHER EXAMPLES.

What is the Quotient of 2088 divided by 346? Facit $6 + \frac{12}{346}$.

$$\begin{array}{r} 346 \overline{) 2088} \\ \underline{2076} \\ 12 \end{array} \quad \begin{array}{r} 346 \\ 6 + 12 \end{array} \left. \vphantom{\begin{array}{r} 346 \\ 6 + 12 \end{array}} \right\} \text{PROOF.}$$

Remainder . . . 12 2088 because $6 \times 346 = 2076 + 12 = 2088$

$$\begin{array}{r} 9457 \overline{) 51786532} \quad (5476 \\ 36 \overline{) 684546} \quad (19015 + \frac{6}{36} \\ 645 \overline{) 594649} \quad (921 + 604 \\ 484 \overline{) 345648} \quad (714 + 72 \\ 948 \overline{) 72048} \quad (76 \\ 64983 \overline{) 44643321} \quad (687 \\ 876 \overline{) 7427604} \quad (8479 \\ 749 \overline{) 4332965} \quad (5785 \\ 9457 \overline{) 51786532} \quad (5476 \\ 754 \overline{) 687567} \quad (911 + \frac{673}{754} \\ 586 \overline{) 578569} \quad (987 + \frac{187}{586} \end{array}$$

LONG DIVISION CONTRACTED.

The Work may be abbreviated, by not setting down the Products under their Dividuals: But then, when you multiply (by the Figure you have put in the Quotient) each Figure of the Divisor, you are to subtract at the same Time, and successively, the Amount of each from the Figures of the Dividual; observing, with Respect to subtracting, the Rules given for subtracting by a single Operation several Quantities from a single Quantity; that is to say, by supposing as many Tens to each Figure in the Dividual as the Case may require; for which Tens, carry as many Units in Mind to join them to the next Product.—Some, instead of bringing down to the Remainder each Figure undone with in the Dividend, scratch those they have, by Subtraction, worked upon. This they call *Scratching Division*; but I do not recommend it, the Work being not so clear as by the other Way.

EXAMPLE.

$$\begin{array}{r} \text{Divide } 84714 \text{ into } 453 \text{ Parts. Facit } 187 + \frac{1}{453} \\ 453 \overline{) 84714} \quad (187 \quad \text{by Scratching} \quad 453 \overline{) 84714} \quad (187 \\ \quad 3941 \quad \text{Division.} \quad \quad 394 \\ \quad 3174 \quad \quad 317 \\ \quad \quad 3 \quad \quad 3 \end{array}$$

ILLUSTRATION.

ILLUSTRATION.

1st, Having found that in 847 it can go once 453, I say, $1 \times 3 = 3 + 4$, to write down, $= 7$ in the Dividual; and carry nothing, there being no Ten.— $1 \times 5 = 5 + 9$, to write down, $= 4$ in the Dividual and 1 Ten to carry.— $1 \times 4 = 4 + 1$, that I carry, $= 5 + 3$, to write down, $= 8$ in the Dividual.

2dly, To the Remainder 394 having brought down and joined the next Figure in the Dividend (1), the present Dividual is 3941; and finding that in 3941 it can go 8 Times 453, I say, $8 \times 3 = 24 + 7$, to write down, $= 1$ in the Dividual and 3 Tens to carry.— $8 \times 5 = 40 + 3$, that I carry, $= 43 + 1$, to write down, $= 4$ in the Dividual and 4 Tens to carry.— $8 \times 4 = 32 + 4$, that I carry, $= 36 + 3$, to write down, $= 39$ in the Dividual.

3dly, To the Remainder 317 having brought down and joined the next Figure in the Dividend (4), the present Dividual is 3174; and finding that in 3174 it can go 7 Times 453, I say, $7 \times 3 = 21 + 3$, to write down, $= 4$ in the Dividual and 2 Tens to carry.— $7 \times 5 = 35 + 2$, that I carry, being equal to 7 in the Dividual, I write down nothing, and carry 3 for the three Tens.— $7 \times 4 = 28 + 3$, that I carry, being equal to 31 in the Dividual, I write down nothing.

Thus, may all Questions in Division be worked; and as in the same Manner all my Operations will be done for the future, I shall give here some other Divisions, that the Learner by working them by this Way, may make himself familiar with it.

679) 50000 (736 + $\frac{256}{679}$
 37) 7210473 (194877 + $\frac{24}{37}$
 473) 2104721 (4449 + $\frac{344}{473}$
 3701) 72109521 (19483 + $\frac{2938}{3701}$
 25204) 321047217 (12737 + $\frac{2869}{25204}$
 2701234) 7210472532 (2669 + $\frac{57086}{2701234}$

CASE III. The Divisor ending with Cyphers.

RULE. Cut off as many Places of the Dividend, which annex to the Remainder at last.

PROOF. As in CASE I.

EXAMPLES.

What is the Quotient of 19976464 divided by 857600? Facit

23 + $\frac{251664}{857600}$

8576|00) 199764|64 (23
 28244
 2516

In

IN WHOLE NUMBERS. 41

In the above Example as there are two Cyphers at the End of the Divisor 857600, so, I cut them off as also two last Figures in the Dividend 19976464. Afterwards, I work as if I had only 199764 to be divided by 8576; and thus find the Quotient 23 and 2516 remain, which prefixing to the 64 cut off = 251664, real Remainder.

$$\begin{array}{r} 3|00 \ 67|48 \ (22 + 148 \\ 4|0 \ 3456|7 \ (864 + 7 \\ 309|0 \ 1409040|0 \ (4560 \\ 6|0000 \ 360|0000 \ (60 \\ 12|00 \ 48|76 \ (4 + 76 \end{array}$$

N. B. When the Divisor is 1, there is no Occasion to divide, because the Quotient will be the same as the given Dividend: When it is 10, there is nothing else to do but to cut off the last Figure for the Remainder, and the other Figures will be the Quotient: When the Divisor is 100, cut off the two last Figures for the Remainder, and the other Figures will be the Quotient: When the Divisor is 1000, cut off the three last Figures, &c.—Thus, if 87567 is to be divided by 100, the Quotient will be 875, and the Remainder 67. The Work is thus: 1|00) 875|67.

CASE IV. When the Divisor can be divided into common Multiples.

RULE. Having found the common Multiples of one Quantity, as by CASE VI. in Multiplication, divide the other Quantity given by one of these common Multiples; then, divide the first Quotient by the next common Multiple, and so on. But, observe that when there is a Remainder you must multiply the first Divisor by the last Remainder, to the Product add the first Remainder (if any); and you will have the true Remainder.

PROOF. As by CASE I. Or, divide reversely by the common Multiple which in the first Operation was the last, then by that common Multiple which was next to the last; and so on.

EXAMPLE.

What is the Quotient of 6450 divided by 132? Facit $48 + \frac{114}{132}$.

$$\begin{array}{l} \text{As } 11 \times 12 \\ \text{or} \\ 12 \times 11 \end{array} \left. \vphantom{\begin{array}{l} \text{As } 11 \times 12 \\ \text{or} \\ 12 \times 11 \end{array}} \right\} = 132, \text{ so, } \begin{array}{r} 11) \ 6450 \\ \underline{} \\ 12) \ 586 + \frac{4}{11} \\ \underline{} \\ \text{Quotient} \ - \ 48 + 10 \times 11 + 4 = 114 \text{ Rem.} \end{array}$$

Or 12) 6450

$$\begin{array}{r} 11) \ 537 + \frac{6}{11} \\ \underline{} \\ \text{Same Quotient} \ - \ 48 + 9 \times 12 + 6 = 114 \text{ Rem.} \\ \text{G} \end{array}$$

ILLUSTRATION.

ILLUSTRATION.

In the above Question the Divisor being 132, I consider which Numbers being multiplied together will make 132, and find that 11 Times 12 make 132, as do likewise 12 Times 11. Therefore I divide, 1st, 6450 by the first common Multiple 11, which gives the Quotient $586 + \frac{4}{11}$.—2dly, That first Quotient 586 by the second common Multiple 12 (without minding yet the $\frac{4}{11}$ that are over), which gives the required Quotient 48 and 10 over; which, to get the true Remainder, I multiply by the first Divisor 11 taking in the 4, Remainder of the first Division; and it gives 114. Or reversely, I divide, 1st, 6450 by 12, which gives the Quotient $537 + \frac{6}{12}$.—2dly, That Quotient 537 by 11 (without minding yet the $\frac{6}{12}$ that are over), which gives the required same Quotient 48 and 9 over, which, to get the true Remainder, I multiply by the first Divisor 12 taking in the 6, Remainder of the first Division; and it gives 114.—And, though these two Ways are sufficient Proofs to one another, yet you may prove your Operations as by CASE I; that is, multiply the Quotient (here 48), by the Divisor (here 132) taking in the Remainder (here 114); and it will give the same Quantity as the given Dividend (here 6450).

OTHER EXAMPLES.

$$18684 \div 54. \text{ Facit } 346$$

$$60000 \div 63. \text{ Facit } 952 + \frac{24}{63}$$

$$4643 \div 72. \text{ Facit } 64 + \frac{55}{72}$$

$$684546 \div 36. \text{ Facit } 19015 + \frac{6}{36}$$

$$3459 \div 144. \text{ Facit } 24 + \frac{134}{144}$$

$$654 \div 108. \text{ Facit } 6 + \frac{66}{108}$$

QUESTIONS TO EXERCISE THE LEARNER.

I. Received 147 Guineas for 49 Months Salary, how many Guineas is it a Month? Facit 3. *The Proof, by Division, of the 1st Question in Multiplication.*

II. How many Pounds are there in 8640 Pence, there being 240 Pence in a Pound? Facit £. 36.

III. How many Pounds are there in 23040 Farthings, there being 960 Farthings in a Pound? Facit £. 24.

IV. A Gentleman had a Garden walled in, containing 9625 Yards, the Breadth was 35 Yards, what was the Length? Facit 275 Yards.

V. A Trader cleared £. 1156 equally in 17 Years, how much did he lay by in a Year? Facit £. 68.

VI. A Square Acre contains 160 Perches: now the Side of a Field is 12 Perches, how much on the other Side will go to make an Acre? Facit $13 + \frac{1}{2}$.

VII. There are 2545 Bullocks to be divided among 509 Men, how many Bullocks will each Man have? Facit 5.

VIII.

IN WHOLE NUMBERS. 43

VIII. 1632 Pounds are to be distributed among 24 Persons, how many Pounds will each Man receive? Facit £.68.

IX. In 1620 Bushels of Coals, how many Chaldrons, there being 36 Bushels in a Chaldron? Facit 45.

X. In 2520 Yards, how many Pieces of 45 Yards each? Facit 56.



THE RULE OF THREE

Teacheth to find a fourth Number proportional to three other Numbers given; two of which are a Supposition, the other is a Demand.

This Sign ($:$) signifies *is to*; and the Sign ($::$) signifies *so*.

HOW TO STATE A QUESTION.

RULE. Always place for third Term the Demand or Number, which requires the Answer. Afterwards, place for first Term the Number of the Supposition, which is of the same Kind or signifies the same Thing with the third Term. And, place for second Term the other Number, which then will be of the same Kind with the fourth required.

HOW TO WORK A QUESTION.

RULE. 1st, If the Answer must exceed the second Number, multiply that second Number by the great Extream, and divide by the less. But,

2d, If the Answer must be less than the second Number, then multiply that second Number by the less Extream, and divide by the great.

For PROOF. Take out the third Term; put the second before the first Term, and make the fourth Term (or Answer found) your third Number. Or, again, take out the first Term; put the Answer found for first Term; the third for second Term; and the second for third Term. Then you'll have another Rule of Three to work, the Answer of which if the same as the Number taken out, will prove the Operation.

* I make no Distinction between a *Rule of Three Direct*, and a *Rule of Three Inverse*, as most Authors have done. The Rules I have given being sufficient in all Cases, I do not chuse to confound the Learner with such needless Differences.

G 2

EXAMPLE,

RULE OF THREE

EXAMPLE I.

For £. 36, how many Yards may I have of Cloth, whose 44 Yards cost £. 24? Facit 66 Yards.

£. Yds. £. Yds.
As 24 : 44 :: 36 : —

36

264

132

24) 1584 (66 Yds. Answer.

144

Yds. £. Yds. £.
PROOF. As 44 : 24 :: 66 : —

66

144

144

44) 1584 (36. Number taken off.

264

ILLUSTRATION.

FOR STATING THE QUESTION.

To State well this Question, I consider which Term requires the Answer, and finding that it is £. 36.—I take care to place it for the third Term; then, as the first must be of the same Kind with the third, so, the Stating will run thus: as £. 24 are to 44 Yards, so £. 36 are to the Number of Yards required; where the third Term is of the same Name with the first, and the second is of the same Name with the fourth Sought.

FOR WORKING THE QUESTION.

The only Difficulty now is to find whether the Answer should exceed, or be less than, the second Number: but, by examining well the Nature of the Question, I easily perceive that it must exceed it; for it is evident, that for £. 36 I will have more than 44 Yards, since 44 Yards cost only £. 24. Therefore, according to the first Rule, I multiply the second Term 44 by the great Extream; which in this Question is 36, and the Product 1584 I divide by the less Extream in this Question 24, which gives the Quotient 66, Number sought. Thus, the Proportion then stands: as £. 24 : 44 Yards :: £. 36 : 66 Yards, where the Answer is greater than the second Term, as was required.

FOR PROVING THE QUESTION.

I cancel the third Term £. 36; I put the second Term (44 Yards) before the first Term (£. 24); and the Answer (66 Yards) I make the third Term; which, all together forms another Rule of Three running thus: as 44 Yards are to £. 24, so 66 Yards are to a Number

IN WHOLE NUMBERS. 45

Number of Pounds required; and being worked as before (because this Question is of the same Nature with the other) gives the £. 36, which had been cancelled.

EXAMPLE II.

How many Yards of 5 Quarters wide are equal in Measure to 50 Yards of 3 Quarters wide? Facit 30 Yards.

Qrs. Yds. Qrs. Yds.	Yds. Qrs. Yds. Qrs.
As 3 : 50 :: 5 : —	PROOF. As 30 : 5 :: 50 : —
3	30
5) 150	5 0) 15 0
30 Answer	3 Number taken off.

ILLUSTRATION,

FOR STATING THE QUESTION.

I seek upon which Term the Question falls, and finding it is 5 Quarters wide, I place it for the third.—Then, as the first must be of the same Kind with the third, so, the Stating runs thus: As 3 Quarters wide are to 50 Yards, so 5 Quarters wide are to the Number of Yards required.

FOR WORKING THE QUESTION.

Now, by examining the Nature of the Question, I find that the Answer should be less than the second Number; since, the breadth being 5 Quarters, I shall not want so many Yards as when the breadth is only 3 Quarters. Therefore, according to the second Rule, I multiply the second Term 50 by the less Extream, which in this Question is 3, and the Product 150 I divide by the great Extream, in this Question 5, which gives the Quotient 30, Number sought.

FOR PROVING THE QUESTION.

Having, in the first Question, made use of the first Method, now I prove this by the second Way, as follows: I cancel the first Term 3: put the Answer found (30 Yards) for first Term; the third (5 Quarters) for second Term; and the second (50 Yards) I make the third Term; which all together forms another Rule of Three running thus: As 30 Yards are to 5 Quarters wide, so 50 Yards are to a Number of Quarters wide required; and being worked as before (because this Question is again of the same Nature with the other) gives the 3 Quarters wide, which had been cancelled.

QUESTIONS

QUESTIONS TO EXERCISE THE LEARNER.

I. If 2805 Pence pay the Carriage of 255 lbs. Weight, how many lbs. Carriage will 33 Pence pay? Facit 3 lbs.

II. If for a certain Sum I have 2400 lbs. carried 36 Miles, how many lbs. may I have carried 18 Miles for the same Money? Facit 4800 lbs.

III. If 5 Flemish Ells are equal to 3 French Ells, how many French Ells are there in 45 Flemish Ells? Facit 27.

IV. I lent a Friend £.200, which, 6 Months after, he returned me. At another Time he lent me £.500: how long may I keep his Money to requite my former Favour? Facit 2 Months $\frac{2}{3}$.

V. If 8 Yards cost £.11; what will 96 Yards come to? Facit £.132.

VI. If £.50 in 12 Months give £.4 Interest, what Principal will give as much in 8 Months? Facit £.75.

N. B. When the Divisor is 1, the Answer is obtained by a single Multiplication. And, when one of the Numbers to be multiplied is 1, the Answer is obtained by a single Division.

If one Horse cost £.7, what will 4 Horses come to? Facit £.28.

If 12 Yards cost £.36, what is it *per* Yard? Facit £.3.

THE RULE OF THREE BY CONTRACTION.

RULE. Take in the Term intended to divide by, such Part or Parts as may be also taken in either of the two other Terms, 'till you bring the Divisor to the lowest Term you can (to Unity, if possible, because then there is no Occasion to divide).—Afterwards, work with the contracted Terms as if they were still the real given Quantities; and the Answer will come the same as if the Operation had been worked by the common Way.

EXAMPLES.

If 72 Yards of Cloth cost £.54; what will 96 Yards of the same come to? Facit £.72.

As 72 Yards : £.54 :: 96 Yards : —£.

12) 6 : 54 : : 8

6) 1 : 9 : : 8

So $9 \times 8 = 72$. Answer.

The Answer must exceed the second Term: Therefore I consider what Part may be taken in the Divisor 72, which may be taken in any of the two other Terms; and finding that both 72 and 96 contain twelfth

twelfth Parts, I first take the 12th Part in both without altering the other Term 54. Thus, I have the contracted Proportion: As 6 Yards : £.54 :: 8 Yards : £.— Then I consider again, which Part being taken in the new Divisor 6, may also be taken in any of the other two Terms of this new Proportion; and finding that the sixth is contained in 6, as likewise in 54, I take the 6th Part in both without altering the other Term 8. Thus, I have the contracted Proportion: As 1 Yard : £.9 :: 8 Yards : £.— where the Divisor being unity, the Answer is obtained by a single Multiplication of the two last Terms, viz. 9 multiplied by 8 give 72.

The Contraction might likewise have been done in the following Manner:

$$\begin{array}{l} \text{As } 72 : 54 :: 96 \\ 9) \quad 9) \\ \quad 8 : 6 :: 96 \\ 8) \quad 8) \\ \quad 1 : 6 :: 12 \\ \text{and then} \\ 6 \times 12 = 72 \end{array}$$

$$\begin{array}{l} \text{Or thus, As } 72 : 54 :: 96 \\ 6) \quad 6) \\ \quad 12 : 9 :: 96 \\ 12) \quad 12) \\ \quad 1 : 9 :: 8 \\ \text{and then} \\ 9 \times 8 = 72 \end{array}$$

It may sometimes happen that, by contracting the Terms (as has been seen) so that one of them be brought to Unity, the Operation can be resolved by a single Division; sometimes by only adding to one of the Terms a Part of one of the others; and sometimes by only Subtracting from one of the Terms a Part of one of the others.

EXAMPLES.

I. If £.65 defray the Expences of 480 Days; how many Pounds will be sufficient to pay the Expences of 240 Days? Facit £.32 + $\frac{1}{2}$ or 10s.

$$\begin{array}{l} \text{Days} \quad \text{Days} \quad \text{The Answer must be less than the} \\ \text{As } 480 : £.65 :: 240 : \text{--- second Term; for it is plain that} \\ 24) \quad 24) \quad \quad \quad 240 \text{ Days will cost only the Half} \\ \quad 2 : 65 :: 1 \quad \quad \quad \text{of 480 Days.} \\ \text{Therefore} \\ 2) 65 \\ \quad 32 + \frac{1}{2} \end{array}$$

II. 21 Shillings are equal to 24 French Livres (when Exchange is at Par); how many French Livres are there then in 480 Shillings? Facit 548 + $\frac{1}{2}$.

As

RULE OF THREE.

s. f. l. *s. f. l.* *The Answer must exceed the second Term, so the first Term 21 is the intended Divisor.*
 As 21 : 24 :: 480 : —

$$\begin{array}{r} 3) \quad 3) \\ 7 : 8 :: 480 : \end{array}$$

$$\begin{array}{r} 7) \quad 7) \\ 1 \quad 1 + \frac{1}{7} :: 480 \end{array}$$

$$\text{So to } \dots 480$$

$$\text{Add } \frac{1}{7} = 68 \frac{4}{7}$$

$$\text{Answer } \dots 548 + \frac{4}{7}$$

III. If 24 French Livres are equal to 21 s; how many Shillings will be equal to 357 French Livres? Facit 312s. + $\frac{2}{3}$.

s. f. l. *s. f. l.* *The Answer must again exceed the second Term, so the first Term 24 is the intended Divisor.*
 As 24 : 21 :: 357 : —

$$\begin{array}{r} 3) \quad 3) \\ 8 : 7 :: 357 \end{array}$$

$$\begin{array}{r} 8) \quad 8) \\ 1 : 1 - \frac{1}{8} :: 357 \end{array}$$

$$\text{Therefore}$$

$$\text{From } \dots 357$$

$$\text{Subtract } \frac{1}{8} = 44 + \frac{5}{8}$$

$$\text{Answer } \dots 312 + \frac{2}{3}$$

N. B. The Contractions of these two last Questions are worth being taken Notice of; as, if well understood, and duly attended to, they will prove very useful.—In Practice, these Contractions are done mentally, and without writing down the Parts one divides by.

QUESTIONS TO EXERCISE THE LEARNER.

I. How many Pieces of 20s. are equal to 240 Pieces of 12 s. Value each? Facit 144 Pieces.

II. If I spend £.36 in 3 Months, how much is it a Year (12 Months)? Facit £.144.

III. If 42 come from 72, what Number do 18 come from? Facit 30 + $\frac{6}{7}$.

IV. If 63 give 49, what Number in the same Proportion will 54 give? Facit 42.

V. If I lend my Friend £. 200 for 12 Months, how long ought he to lend me £. 150 to requite my Kindness? Facit 16 Months.

VI. If (£. 20) worth of Wine are sufficient to serve an Ordinary of 100 Men, when the Tun is sold £. 30, how many will (£. 20) worth suffice, when the Tun is sold for but £. 24? Facit 125 Men.

VII. If £. 100 Principal give, in 12 Months, £. 4 Interest, what Principal will, in 18 Months, give as much Interest? Facit £. 66 + $\frac{2}{3}$.

THE END OF THE FIRST PART.

THE SECOND PART.

ARITHMETIC in APPLICATE NUMBERS.

TABLES of MONEY, WEIGHTS, and MEASURES.

MONEY.

4 Farthings, make	1 Penny, marked thus,	D.
12 Pence . . .	1 Shilling	S.
20 Shillings . . .	1 Pound	£.

N.B. One *Farthing*, marked thus: $\frac{1}{4}$, is to be considered as $\frac{1}{4}$ if written thus:

Two Farthings, or a <i>Halfpenny</i>	$\frac{1}{2}$	2
Three Farthings	$\frac{3}{4}$	3

Farthings

4	=	1 Penny
48	=	12 = 1 Shilling
960	=	240 = 20 = 1 Pound.

TROY WEIGHT.

24 Grains make	1 Penny-Weight, marked thus:	Pwts. or Dwts.
20 Pwts.	1 Ounce	Oz. or Ou.
12 Oz.	1 Pound	lb.

Grains

24	=	1 Penny-Weight
480	=	20 = 1 Ounce
5760	=	240 = 12 = 1 Pound

H

AVOIR

TABLES of WEIGHTS and MEASURES.

AVOIR DU POIDS WEIGHT.

16 Drams, make 1 Ounce, marked thus:	oz.
16 oz. 1 Pound	lb.
28 lbs. 1 Quarter	qr.
4 qrs. 1 Hundred	Ct.
20 cts. 1 Tun	T.

16 =	1 Ounce.
256 =	16 = 1 Pound.
7168 =	448 = 28 = 1 Quarter.
25672 =	192 = 112 = 4 = 1 Hundred.
573440 =	35840 = 2240 = 80 = 20 = 1 Tun.

APOTHECARIES WEIGHT.

20 Grains make 1 Scruple, marked thus:	℥
3 Scruples 1 Dram	ʒ
8 Drams 1 Ounce	℥
12 Ounces 1 Pound	lb

Grains	
20 =	1 Scruple.
60 =	3 = 1 Dram.
480 =	24 = 8 = 1 Ounce.
5760 =	288 = 96 = 12 = 1 Pound.

N. B. Apothecaries only mix their Drugs by this Weight; they buy and sell them by Avoir du Poids Weight.

ENGLISH DRY-MEASURE.

8 Pints make 1 Gallon (or 4 Quarts), marked thus:	Gal.
2 Gal. 1 Peck (or 4 Pottles)	P.
4 Pecks 1 Bushel	B.
4 Bushels 1 Comb	C.
2 Combs 1 Quarter	qr.
5 Quarters 1 Wey or Tun	W. or T.
2 Wey or Tuns 1 Last	Lt.

Pints	
8 =	1 Gallon.
16 =	2 = 1 Peck.
64 =	8 = 4 = 1 Bushel.
256 =	32 = 16 = 4 = 1 Comb.
512 =	64 = 32 = 8 = 2 = 1 Quarter.
2560 =	320 = 160 = 40 = 10 = 5 = 1 Wey.
5120 =	640 = 320 = 80 = 20 = 10 = 2 = 1 Last.

CLOTH-

TABLES of MEASURES:

51

CLOTH-MEASURE.

2 1/4	Inches make	1 Nail, marked thus:	Nl.
4	Nails	1 Quarter	Qr.
4	Quarters	1 Yard	Yd.

Inches

$$2 \frac{1}{4} = 1 \text{ Nail.}$$

$$9 = 4 = 1 \text{ Quarter.}$$

$$36 = 16 = 4 = 1 \text{ Yard.}$$

N.B.	{	3 Quarters of a Yard = an Ell Flemish.
		5 Quarters (or 1 Yard and $\frac{1}{4}$) = an Ell English.
		6 Quarters (or 1 Yard and $\frac{1}{2}$) = an Ell French.
		16 Nails = 1 Yard; 20 Nails = 1 Ell English; 12 Nails = an Ell Flemish; 24 Nails = an Ell French.

WINE MEASURE.

2	Pints make	1 Quart, marked thus:	Qu.
4	Quarts	1 Gallon	Gal.
63	Gal.	1 Hoghead	Hhd.
4	Hogheads	1 Tun	T.

Pints

$$2 = 1 \text{ Quart.}$$

$$8 = 4 = 1 \text{ Gallon.}$$

$$504 = 252 = 63 = 1 \text{ Hoghead.}$$

$$2016 = 1008 = 252 = 4 = 1 \text{ Tun.}$$

N.B.	An Anchor of Brandy or Rum	= 16 Gallons.—A Runlet =
	18 Gallons.—A Barrel of Wine or Vinegar	= 31 1/2 Gallons.
	—A Tierce = 42 Gallons.—A Butt or Pipe	= 2 Hogheads
	or 126 Gallons.	

ALE AND BEER MEASURE.

8	Gallons of Ale make	1 Firkin of Ale, marked thus:	A. F
9	Gallons of Beer	1 Firkin of Beer	B. F
2	Firkins	1 Kilderkin	Kild.
2	Kilderkins	1 Barrel	Bar
1 1/2	Barrel	1 Hoghead	Hhd
2	Hhds.	1 Butt	Butt

$$8 \text{ Gal. of Ale, or } 9 \text{ Gal. of Beer} = 1 \text{ Firkin.}$$

$$16 \text{ or } 18 = 2 = 1 \text{ Kilderkin.}$$

$$32 \text{ or } 36 = 4 = 2 = 1 \text{ Barrel.}$$

$$48 \text{ or } 54 = 6 = 3 = 1 \frac{1}{2} = 1 \text{ Hhd.}$$

$$96 \text{ or } 108 = 12 = 6 = 3 = 2 = 1 \text{ Butt.}$$

H 2

LONG

TABLES of MEASURES.

LONG MEASURE.

3	Barley Corns make	1 Inch, marked thus:	In.
12	Inches	1 Foot	F.
3	Feet	1 Yard	Yd.
5½	Yards	1 Rod, Pole, or Perch	Rod, or P.
40	Poles	1 Furlong	Fur.
8	Furlongs	1 Mile	M.

Barley Corns

3	=	1 Inch.	
36	=	12 =	1 Foot.
108	=	36 = 3 =	1 Yard.
594	=	198 = 16½ = 5½ =	1 Pole.
23760	=	7920 = 660 = 220 = 40 =	1 Furlong.
190080	=	63360 = 5280 = 1760 = 320 = 8 =	1 Mile.

N.B. 6 Feet make 1 Fathom.

1 Acre = 4 Roods; 1 Rood = 40 Rods or Perches, in LAND MEASURE.

3 Miles = 1 League; 20 Leagues = 1 Degree, commonly; but a Degree of a great Circle, measured on the Surface of the Earth, has been found = 69½ Miles = 25 French Leagues.

SQUARE MEASURE.

144	Inches make	1 Foot.
9	Feet	1 Yard.
100	Feet	1 Square of Flooring.
272½	Feet	1 Rod.
40	Rods	1 Rood.
4	Roods (= 160 Rods = 4840 Yards)	make 1 Acre of Land.
640	Acres make	1 Square Mile.
30	Acres	1 Yard of Land.
100	Acres	1 Hide of Land.

Inches 144	=	1 Foot.
1296	=	9 = 1 Yard.
39204	=	272½ = 30½ = 1 Pole.
1568160	=	10890 = 1210 = 40 = 1 Rod.
6272640	=	43560 = 4840 = 160 = 4 = 1 Acre.

SOLID MEASURE.

1728 Inches make 1 Solid Foot.

27 Feet = 1 Yard, or Load of Earth.

40 Feet of Round Timber } = 1 Tun, or Load.
40 Feet of Hewn Timber }

108 Solid

TABLES of MEASURES.

53

168 Solid Feet, that is, 12 Feet in Length, 3 Feet in Breadth, and 3 deep; or, commonly, 14 Feet long, 3 Feet 1 Inch broad, and 3 Feet 1 Inch deep; is a Stack of Wood.

128 Solid Feet, that is, 8 Feet long, 4 Feet broad, and 4 Feet deep, is a Cord of Wood.

TIME.

For common Purposes; but not in Trade and transacting Business.

60 Seconds	make 1 Minute,	marked	1', or M.
60'		1 Hour	H.
24 Hours		1 Day	D.
7 Days		1 Week	W.
4 Weeks		1 Month	Mo.
13 Months		1 Year	Yr.

60" =	1' (Minute).
3600 =	60 = 1 Hour.
86400 =	1440 = 24 = 1 Day.
604800 =	10080 = 168 = 7 = 1 Week.
2419200 =	40320 = 672 = 28 = 4 = 1 Month.
30449600 =	524160 = 8736 = 364 = 52 = 13 = 1 Year.

Otherwise,

60" =	1'
3600 =	60 = 1 Hour.
86400 =	1440 = 24 = 1 Day.
$\left\{ \begin{array}{l} 31556937 = 525949 = 8765 = 365 + \left\{ \begin{array}{l} 5^h. 48' 57'' \end{array} \right\} \frac{1}{4} = 1 \text{ Tropical} \\ \text{valued.} \end{array} \right. \text{Day}$	
$\left\{ \begin{array}{l} 31643337 = 527389 = 8789 = 366 = 1 \text{ Bissextile, or Leap-Year,} \end{array} \right.$	

Here may be observed that, two Halves ($\frac{2}{2}$), three Thirds ($\frac{3}{3}$), four Fourths ($\frac{4}{4}$), five Fifths ($\frac{5}{5}$), six Sixths ($\frac{6}{6}$), seven Sevenths ($\frac{7}{7}$), eight Eighths ($\frac{8}{8}$), nine Ninths ($\frac{9}{9}$), ten Tenths ($\frac{10}{10}$), eleven Elevenths ($\frac{11}{11}$), twelve Twelfths ($\frac{12}{12}$), &c. make each one Whole or 1 (Integer). And therefore, in Fractions, to compleat a Whole, you must add to the Top Figure or Figures (Numerator), as many Units as are wanting to come up to the Quantity expressed by the Denominator's Figure or Figures; thus, to make a Whole: in $\frac{1}{2}$, the Difference is $\frac{1}{2}$ (because 1 and 1 make 2): in $\frac{1}{3}$, the Difference is $\frac{2}{3}$: in $\frac{2}{3}$, the Difference is $\frac{1}{3}$: in $\frac{1}{4}$, the Difference is $\frac{3}{4}$: in $\frac{3}{4}$, the Difference is $\frac{1}{4}$: in $\frac{1}{5}$, the Difference is $\frac{4}{5}$: in $\frac{4}{5}$, the Difference is $\frac{1}{5}$: in $\frac{2}{5}$, the Difference is $\frac{3}{5}$: in $\frac{3}{5}$, the Difference is $\frac{2}{5}$: in $\frac{1}{6}$, the Difference is $\frac{5}{6}$: in $\frac{5}{6}$, the Difference is $\frac{1}{6}$: in $\frac{1}{8}$, the Difference is $\frac{7}{8}$: in $\frac{7}{8}$, the Difference is $\frac{1}{8}$: and so on.

ADDITION.



ADDITION

In Applicate Numbers, is performed the same as in Whole Numbers; but you are to observe, that Ten is the Ratio of Whole Numbers only, and that in Applicate Numbers the Ratio varies, according to the Quantity of Parts one superior Denomination is worth of a next inferior Denomination. Thus, in the adding up of the Parts or Denominations neither required, nor considered, as Integers (such as Farthings coming after Pence; Pence after Shillings, Shillings after Pounds; or, Grains after Penny-Weights, Penny-Weights after Ounces, Ounces after Pounds, &c), instead of carrying one for each Ten; you must carry one for each Integer or Whole Number only of the next superior Denomination: Therefore, for Addition, take this

GENERAL RULE.

Add the first Row (on the Right-Hand) or lowest Denomination; as in Integers: then divide its Total by as many of the same Denomination as make one of the next greater; set down the Remainder under the Row added, and the first Line; and write under the second Line (and carry) the Quotient to the next greater Denomination Left-Hand: Thus proceed to the last, which add as in simple Addition*.

PROOF. As in Integers or Whole Numbers.

MONEY.

RULE. For every 4 Farthings carry 1 to the Pence. For every 12 Pence carry 1 to the Shillings. For every 20 Shillings, carry 1 to the Pounds.

* To render this more intelligible, observe that—for Instance, in MONEY.—If you have Farthings: after having, as in Whole Numbers, found their Total; you must divide that Total by 4, because 4 Farthings make 1 Penny, next higher Denomination. If you have Pence: after having found their Total, divide it by 12, because 12 Pence make 1 Shilling, next higher Denomination. If you have Shillings: after having found their Total, divide it by 20, because 20 Shillings make 1 Pound, next higher Denomination.—In TROY-WEIGHT.—If you have Grains to be added together: after having found their Total, divide it by 24, because 24 Grains make 1 Penny-Weight, next higher Denomination. If you have Penny-Weights: after having found their Total, divide it by 20, because 20 Penny-Weights make 1 Ounce. If you have Ounces: divide their Total by 12, because 12 Ounces make 1 lb. After the same Manner you are to work for the other Weights and Measures.

IN APPLICATE NUMBERS. 55

N. B. When you are at the Column of Shillings, for more Ease, don't mind the Tens of each Quantity of Shillings; but, cast up the Row of their Units, write down what is under Ten or above the Tens of these Units under the first Line, and carry the Number of Tens under the second Line at the Row of Tens of Shillings: Then, join these Tens carried to the other Tens of Shillings; and, if their Sum be even, take the Half of it and carry that Half under the second Line at the Column of Units of Pounds; if their Total be odd (as 9 &c). write down 1 of them under the first Line at the Row of the Tens of Shillings; and then an even Number will remain (viz. 8 in 9) the Half of which (being 4) carry and write under the second Line at the Row of Units of Pounds. *This Contraction is according to CASE III. in Division of Whole Numbers.*

EXAMPLE.

What is the Total of £. 4875. 17. 10 $\frac{1}{2}$ + 3978. 18. 5 $\frac{3}{4}$ + 4689. 17. 6 $\frac{1}{4}$ + 8978. 4. 3 $\frac{3}{4}$ + 8764. 18. 11 $\frac{1}{2}$? Facit 31287. 17. 1 $\frac{3}{4}$.

£.	s.	d.
4875	- 17	- 10 $\frac{1}{2}$
3978	- 18	- 5 $\frac{3}{4}$
4689	- 17	- 6 $\frac{1}{4}$
8978	- 4	- 3 $\frac{3}{4}$
8764	- 18	- 11 $\frac{1}{2}$

Total . . 31287 - 17 - 1 $\frac{3}{4}$

Numbers carried 4333 - 33 - 2

ILLUSTRATION.

Here, *Farthings* being the less Species, and considering $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, $\frac{1}{2}$ as if written thus: 2, 3, 1, 3, 2, I cast them up and find their Amount to be 11; wherefore I say, in 11 Farthings, how many Times 4 (that is, how many Pence)? and finding it goes twice and 3 over, I write down the 3 Farthings over, under the first Line at the Row of Farthings, thus ($\frac{3}{4}$), and carry the 2 Pence, which I write down under the second Line at the Row of Pence.

At the Column of Pence: 2 (under the second Line), that I carry, + 11 + 3 + 6 + 5 + 10 = 37; wherefore I say, in 37 Pence, how many Times 12 (that is, how many Shillings)? and finding it goes 3 Times and 1 over, I write down the 1 Penny over, under the first Line at the Row of Pence, and carry the 3 Shillings, which I write down under the second Line at the Row of Units of Shillings.

At the Column of Units of Shillings: 3 (under the second Line), that I carry, + 8 + 4 + 7 + 8 + 7 = 37, in which 37 there being

being 3 Tens and 7 Units over, I write down the 7 Shillings over, under the first Line at the Row of Units of Shillings, and carry the 3 Tens, which I write down under the second Line at the Row of Tens of Shillings.

At the Column of *Tens of Shillings*: 3 (under the second Line), that I carry, $+ 1 + 1 + 1 + 1 + 1 = 7$, the Half of which being 3 and 1 over, I write the 1 under the first Line at the Column of Tens of Shillings, and carry the 3 under the second Line at the Units of Pounds; for it is evident, that 7 Tens of Shillings are equal to 3 Pounds 10 Shillings.

Now being come to Pounds, which are in this Question Integers or Whole Numbers, I work with them as directed for Whole Numbers, which give 31287; and thus I find the Total required to be £. 31287. 17, 1 $\frac{3}{4}$.

PROOF. At the *first Column Left-Hand*, $4 + 3 + 4 + 8 + 8 = 27 + 4$ under the second Line at that Row = the 31 under the first Line. At the *second Column*, $8 + 9 + 6 + 9 + 7 = 39 + 3$ under the second Line = 42, that is, the 2 under the first Line, and the 4 Tens under the second Line, next Column Left-Hand. At the *third Column*, $7 + 7 + 8 + 7 + 6 = 35 + 3$ under the second Line = the 8 under the first Line, and the 3 Tens under the second Line fore Column. At the *fourth Column*, $5 + 8 + 9 + 8 + 4 = 34 + 3$ under the second Line = the 7 under the first Line, and the 3 Tens under the second Line fore Column. At the *Column of Tens of Shillings*, $1 + 1 + 1 + 1 = 4 + 3$ under the second Line = 7 Tens or 3 Pounds that I had carried under the second Line fore Column, and 1 Ten written under the first Line; for it is evident, that twice 3 Pounds (or 6 Tens) + 1 Ten of Shillings = 7 Tens of Shillings. At the *Column of Units of Shillings*, $7 + 8 + 7 + 4 + 8 = 34 + 3$ under the second Line = 37, or 7 under the first Line, and 3 Tens under the second Line fore Column. At the *Column of Pence*, $10 + 5 + 6 + 3 + 11 = 35 + 2$ under the second Line = 37 *d.*, or 1 *d.* under the first Line, and 3 Shillings carried under the second. At the *Column of Farthings*, $2 + 3 + 1 + 3 + 2 = 11$ Farthings, or $\frac{3}{4}$ under the first Line, and 2 Pence under the second.

OTHER EXAMPLES.

£.	s.	£.	s.	£.	s.	£.	s.	d.	£.	s.	d.
84	- 17	47	- 8	7	- 18	68	- 14	- 5	45	- 8	- 19
47	- 18	84	- 9	9	- 18	49	- 16	- 7	78	- 4	- 9
79	- 17	68	- 7	8	- 19	38	- 17	- 9	49	- 11	- 11
47	- 16	9	- 8	9	- 16	47	- 6	- 7	79	- 17	- 8
47	- 8	84	- 6	6	- 12	34	- 7	- 5	84	- 9	- 7
Total.	397 - 16	293 - 18	43 - 3	239 - 2 - 9	337 - 12 - 9						
33 - 3		31		4 - 3		33 - 32		32 - 33			

IN APPLICATE NUMBERS. 57

£.	s.	d.	£.	s.	d.	£.	s.	d.	s.	d.
39	- 16	- 11 $\frac{3}{4}$	54	- 17	- 9 $\frac{3}{4}$	8	- 4	- 7 $\frac{1}{4}$	19	- 6
21	- 7	- 9 $\frac{1}{2}$	8	- 9	- 7 $\frac{1}{4}$	5	- 16	- 11 $\frac{3}{4}$	3	- 7 $\frac{1}{4}$
48	- 17	- 10 $\frac{1}{2}$	9	- 0	- 0	4	- 8	- 9 $\frac{1}{4}$	3	- 4 $\frac{1}{2}$
34	- 19	- 7 $\frac{1}{2}$	4	- 6	- 0 $\frac{3}{4}$	2	- 6	- 7 $\frac{1}{2}$	0	- 0 $\frac{1}{2}$
45	- 16	- 10 $\frac{1}{4}$	3	- 19	- 7 $\frac{3}{4}$	3	- 4	- 6 $\frac{1}{4}$	12	- 4 $\frac{1}{2}$
39	- 17	- 8 $\frac{3}{4}$	16	- 4	- 8 $\frac{1}{4}$	4	- 2	- 1 $\frac{1}{2}$	3	- 7 $\frac{3}{4}$
Tot.	230	- 16	- 10 $\frac{1}{4}$	96	- 17	- 9 $\frac{3}{4}$	28	- 3	- 7 $\frac{1}{2}$	2 - 2 - 7 -
	44	- 44	- 3	32	- 32	- 2	2	- 33	- 2	22 - 3

TROY WEIGHT.

RULE. For every 24 Grains, carry 1 to the Penny-Weights. For every 20 Penny-Weights, carry 1 to the Ounces. For every 12 Ounces, carry 1 to the Pounds.

What has been observed for Shillings, may be applied to the Penny-Weights.

EXAMPLES.

oz.	dwt.	gr.	lbs.	oz.	dwt.	gr.	lbs.	oz.	dwt.
6	- 14	- 22	8	- 3	- 12	- 20	4	- 4	- 10
3	- 8	- 4	48	- 2	- 14	- 23	7	- 10	- 9
5	- 13	- 16	96	- 10	- 13	- 21	18	- 11	- 14
4	- 8	- 19	48	- 8	- 11	- 20	9	- 7	- 9
3	- 7	- 5	9	- 9	- 9	- 9	8	- 4	- 7
4	- 3	- 9	86	- 10	- 11	- 21	6	- 7	- 5
27	- 16	- 3	298	- 9	- 14	- 18	55	- 9	- 14
2	- 33		43	- 3	- 24		43	- 2	- 3

AVOIR DU POIDS WEIGHT.

RULE. For every 16 Drams, carry 1 to the Ounces. For every 16 Ounces, carry 1 to the Pounds. For every 28 lbs, carry 1 to the Quarters. For every 4 Quarters, carry 1 to the Hundreds. For the Hundreds (coming after Tuns), work as for Shillings.

ADDITION

EXAMPLES.

lbs.	oz.	dr.	cwts.	grs.	lbs.	tuns.	cwts.	grs.	lbs.	oz.	dr.
48	14	15	24	3	4	28	17	3	36	13	14
56	13	14	46	2	27	9	19	2	8	9	11
47	5	13	34	1	20	14	16	1	19	15	10
3	8	9	8	2	14	8	9	2	6	8	7
18	4	7	29	1	17	4	15	1	4	7	6
29	3	10	8	2	19	7	6	2	3	9	4
42	6	14	4	1	14	8	3	2	0	7	6
246	10	2	157	0	3	82	8	1	80	7	10
43	5		44	4		54	43		44	3	

APOTHECARIES WEIGHT.

RULE. For Grains, work as for Shillings. For every 3 Scruples, carry 1 to the Drams. For every 8 Drams, carry 1 to the Ounces. For every 12 Ounces, carry 1 to the lbs.

EXAMPLES.

3.	3.	gr.	3.	3.	3.	gr.	lbs.	3.	3.	3.	gr.
7	2	19	4	3	2	18	6	2	4	1	8
8	1	17	2	1	1	16	2	7	4	2	17
3	2	18	4	3	0	17	8	11	7	1	14
4	2	13	5	7	2	19	4	10	6	2	19
3	1	17	4	0	0	16	3	9	4	0	17
2	0	19	2	6	1	15	1	8	1	0	4
31	1	3	23	7	2	1	28	2	5	0	19
4	5	4	2	3	5	4	4	3	3	3	3

ENGLISH DRY MEASURE.

RULE. For every 8 Pints, or 4 Quarts, carry 1 to the Gallons. For every 2 Gallons, carry 1 to the Pecks. For every 4 Pecks, or 8 Gallons, carry 1 to the Bushels. For every 4 Bushels, carry 1 to the Combs. For every 2 Combs, or 8 Bushels, carry 1 to the Quarters. For every 5 Quarters, carry 1 to the Weys. For every 2 Weys, carry 1 to the Lafts.—WHEN FROM BUSHELS TO CHALDRONS: For every 36 Bushels, carry 1 to the Chaldrons.

EXAMPLES.

IN APPLICATE NUMBERS. 59

EXAMPLES.

<i>grs. bu. p.</i>	<i>la. w. grs. co. bu. p. gal. pint.</i>	<i>ch. bu. p.</i>
75 - 7 - 2	4 - 1 - 4 - 1 - 2 - 3 - 1 - 7	75 - 27 - 2
37 - 2 - 3	6 - 0 - 3 - 1 - 3 - 2 - 0 - 6	48 - 35 - 3
51 - 2 - 0	3 - 1 - 2 - 0 - 1 - 1 - 1 - 5	24 - 29 - 2
49 - 6 - 3	4 - 1 - 4 - 1 - 0 - 1 - 0 - 4	36 - 17 - 1
214 - 3 - 0	20 - 0 - 0 - 1 - 0 - 1 - 0 - 6	186 - 2 - 0
22 - 2 -	3 - 3 - 2 - 2 - 2 - 2 - 2 -	23 - 2 -

CLOTH MEASURE.

RULE. For every 2 $\frac{1}{4}$ Inches, carry 1 to the Nails. For every 4 Nails, carry 1 to the Quarters. For every 4 Quarters, carry 1 to the Yards.—If, instead of Yards, there are Flemish Ells; for every 3 Quarters, carry 1. If there are English Ells; for every 5 Quarters, carry 1. If there are French Ells; for every 6 Quarters, carry 1.

EXAMPLES.

<i>Fl. e. grs. n.</i>	<i>E. e. grs. n.</i>	<i>Fr. e. grs. n.</i>	<i>yds. grs. n.</i>
8 - 2 - 2	4 - 3 - 2	9 - 4 - 1	8 - 3 - 3
4 - 2 - 3	9 - 4 - 3	8 - 3 - 3	7 - 2 - 1
8 - 1 - 2	8 - 3 - 2	9 - 2 - 2	8 - 3 - 3
9 - 0 - 3	7 - 1 - 1	8 - 4 - 1	4 - 2 - 1
8 - 2 - 3	9 - 2 - 3	7 - 3 - 1	9 - 1 - 2
40 - 1 - 1	40 - 0 - 3	44 - 0 - 0	39 - 1 - 2
3 - 3 -	3 - 2 -	3 - 2 -	3 - 2 -

WINE MEASURE.

RULE. For every 2 Pints, carry 1 to the Quarts. For every 4 Quarts, carry 1 to the Gallons. For every 18 Gallons, carry 1 to the Runlets. For every 42 Gallons, carry 1 to the Tierces. For every 63 Gallons, carry 1 to the Hogsheads. For every 4 Hogsheads, carry 1 to the Tuns.

EXAMPLES.

<i>run. gal. qts.</i>	<i>tier. gal. qts.</i>	<i>t. hds. gal. qts. pint.</i>
28 - 17 - 2	84 - 41 - 3	8 - 3 - 62 - 3 - 1
39 - 15 - 3	76 - 36 - 2	4 - 2 - 45 - 0 - 1
48 - 16 - 1	8 - 18 - 1	8 - 0 - 36 - 2 - 0
39 - 14 - 3	0 - 29 - 3	0 - 3 - 60 - 0 - 0
46 - 8 - 2	25 - 40 - 2	4 - 0 - 35 - 2 - 0
0 - 13 - 1	17 - 8 - 0	1 - 2 - 4 - 1 - 1
204 - 14 - 0	214 - 6 - 3	28 - 1 - 55 - 1 - 1
44 - 3 -	34 - 2 -	3 - 3 - 2 - 1 -

ALE AND BEER MEASURE.

RULE. For every 4 Quarts, carry 1 to the Gallons. Then, if *Ale*, for every 8 Gallons, carry 1 to the Firkins; if *Beer*, for every 9 Gallons, carry 1 to the Firkins. For every 2 Firkins, carry 1 to the Kilderkins. For every 2 Kilderkins, or 4 Firkins, carry 1 to the Barrels. Also, for every 48 Gallons of *Ale*, carry 1 to the Hogsheads; but if it is *Beer*, for every 54 Gallons, carry 1.

EXAMPLES.

<i>a. bar. fir. gal.</i>	<i>b. bar. fir. gal.</i>	<i>a. hds. gal. qts.</i>	<i>b. hds. gal. qts.</i>
36 - 3 - 7	45 - 3 - 8	47 - 47 - 3	39 - 53 - 3
49 - 2 - 6	79 - 2 - 7	39 - 36 - 2	25 - 29 - 4
39 - 1 - 5	54 - 2 - 8	4 - 12 - 1	38 - 14 - 3
47 - 3 - 7	37 - 3 - 4	3 - 8 - 2	49 - 8 - 2
89 - 2 - 6	25 - 3 - 7	76 - 14 - 3	0 - 36 - 0
263 - 2 - 7	244 - 0 - 7	171 - 23 - 3	153 - 34 - 2
43 - 3 -	34 - 3 -	32 - 2 -	32 - 2 -

LONG MEASURE.

RULE. For every three Barley-Corns, carry 1 to the Inches. For every 12 Inches, carry 1 to the Feet. For every 3 Feet, carry one to the Yards. (For every 2 Yards, or 6 Feet, carry one to the Fathoms). For every $5\frac{1}{2}$ Yards, carry 1 to the Poles, Rods, or Perches. For every 40 Poles, carry 1 to the Furlongs. For every 8 Furlongs, carry 1 to the Miles. For every 3 Miles, carry 1 to the Leagues.

EXAMPLES.

<i>feet. inch. b. c.</i>	<i>yards. feet. in.</i>	<i>m. furl. p.</i>	<i>lea. m. furl.</i>
27 - 9 - 2	25 - 2 - 11	8 - 7 - 39	9 - 2 - 7
45 - 10 - 1	45 - 0 - 10	4 - 6 - 35	8 - 1 - 6
34 - 11 - 2	49 - 2 - 8	9 - 4 - 28	0 - 2 - 4
47 - 8 - 2	8 - 1 - 9	3 - 6 - 7	8 - 0 - 7
34 - 10 - 1	4 - 2 - 8	0 - 5 - 0	3 - 1 - 5
191 - 2 - 2	134 - 1 - 10	27 - 6 - 29	31 - 0 - 5
34 - 2 -	33 - 3 -	3 - 2 -	3 - 3 -

LAND MEASURE.

RULE. For every 40 Rods, Perches, or Poles, carry 1 to the Roods. For every 4 Roods, carry 1 to the Acres.

EXAMPLES.

IN APPLICATE NUMBERS. 61

EXAMPLES.

<i>a.</i>	<i>r.</i>	<i>p.</i>	<i>a.</i>	<i>r.</i>	<i>p.</i>	<i>a.</i>	<i>r.</i>	<i>p.</i>	<i>a.</i>	<i>r.</i>	<i>p.</i>
75	- 3	- 27	27	- 1	- 35	26	- 1	- 31	32	- 1	- 14
36	- 2	- 15	29	- 2	- 19	19	- 2	- 17	27	- 0	- 16
97	- 1	- 16	37	- 1	- 15	55	- 1	- 14	31	- 2	- 15
35	- 2	- 15	95	- 2	- 27	79	- 3	- 21	19	- 1	- 18
27	- 1	- 14	62	- 0	- 13	95	- 2	- 14	36	- 2	- 37
272	- 3	- 7	252	- 0	- 29	276	- 3	- 17	147	- 0	- 20
32	- 2	-	32	- 2	-	32	- 2	-	22	- 2	-

SQUARE MEASURE.

RULE. For every 144 Square Inches, carry 1 to the Square Feet. For every 9 Square Feet, carry 1 to the Square Yards.

EXAMPLES.

<i>Sq. yds.</i>	<i>feet.</i>	<i>inch.</i>	<i>Sq. yds.</i>	<i>feet.</i>	<i>inch.</i>	<i>Sq. yds.</i>	<i>feet.</i>	<i>inch.</i>
17	- 5	- 71	38	- 8	- 143	44	- 7	- 14
3	- 8	- 143	45	- 7	- 29	9	- 4	- 48
24	- 7	- 100	8	- 6	- 47	7	- 6	- 107
36	- 6	- 66	2	- 7	- 8	2	- 4	- 98
8	- 4	- 43	0	- 5	- 121	3	- 2	- 4
91	- 5	- 135	96	- 8	- 60	67	- 6	- 127
33	- 2	-	23	- 2	-	22	- 1	-

TIME for common Purposes.

RULE. For every 60 Seconds, carry 1 to the Minutes. For every 60 Minutes, carry 1 to the Hours. For every 24 Hours, carry 1 to the Days. For every 7 Days, carry 1 to the Weeks. For every 4 Weeks, carry 1 to the Months. For every 13 Months, carry 1 to the Years.

EXAMPLES.

<i>H.</i>	<i>'</i>	<i>"</i>	<i>D.</i>	<i>H.</i>	<i>'</i>	<i>W.</i>	<i>D.</i>	<i>H.</i>
54	- 59	- 59	68	- 23	- 45	8	- 6	- 11
48	- 8	- 9	38	- 21	- 36	4	- 5	- 21
36	- 47	- 48	49	- 20	- 39	3	- 5	- 14
67	- 50	- 40	36	- 19	- 14	5	- 4	- 22
98	- 47	- 45	45	- 14	- 13	6	- 4	- 23
306	- 34	- 21	240	- 3	- 27	29	- 6	- 19
33	- 3	-	44	- 2	-	3	- 3	-

QUESTIONS

QUESTIONS TO EXERCISE THE LEARNER.

I. If the yearly Rent of a House is £. 24 *per annum*, King's Tax included. Window Lights 19s. 10d. Poor's Rates £. 1 - 9 - 8. Watch 15s. Water £. 1 - 7 - 6. Scavenger 9s. How much does the whole amount to *per annum*? Facit £. 29 - 1 - 0.

II. A Gentleman having built a House, finds by the Bills brought in, that the Mason's Work is £. 307 - 14 - 3½. The Bricklayer's, £. 276 - 9 - 10. The Carpenter's, £. 769 - 18 - 7¼. The Plumber's, £. 107 - 3 - 9. The Painter's, £. 69 - 12. The Glazier's, £. 24 - 7. The Smith's, £. 68 - 0 - 9. The Plaisterer's, £. 47 - 1. What does the whole Building cost? Facit £. 1670 - 7 - 2¾.

III. A Banker, upon the Balance of his Accompts, finds himself indebted, viz. To A, £. 340 - 17 - 5. To B, £. 49 - 8 - 7½. To C, £. 37 - 0 - 9¾. To D, £. 197 - 19 - 10. To E, £. 4047 12 - 11½. To F, £. 349 - 16 - 4. What does the Whole amount to? Facit £. 5022 - 15 - 11¾.

IV. Paid this Day, viz. To John Bell, £. 97 - 14 - 6½. To Thomas Bee, £. 6 - 17. To Edward Glyn, £. 5 - 18 - 10¾. To Peter Fair, £. 8 - 0 - 11¾. To George Keel, £. 4 - 6 - 9¼. To Henry Brooke, £. 0 - 18 - 6. How much is it in all? Facit £. 123 - 16 - 7¾.

V. I owe as follows: To Green, £. 37 - 14 - 8½. To Jee, £. 49 - 8 - 9¼. To Lewes, £. 107 - 9 - 10½. To Dumee, £. 49 - 10 - 11¾. To Tringham, £. 113 - 13 - 10¾. To Edmonds, £. 390 - 9 - 7½. To Fairman, £. 7 - 14. To Covert, £. 39 - 16 - 7¼. What do I owe in all? Facit £. 756 - 1 - 10¼.

VI. A Merchant, upon settling his Affairs, finds in ready Cash £. 607 - 19 - 7. In Bank Notes, £. 3040. In several Draughts and Promissory Notes, £. 2846 - 17 - 7½. In Goods in his Warehouse, £. 3476 - 19 - 6. In Shares in different Ships, £. 347 - 19 10¾. And his Household Furnitures he values to £. 2794. I demand, How much he is worth? Facit £. 13113 - 16 - 7¼.

VII. A Ship returned Home, laden, viz. with Pepper to the Value of £. 507 - 19. With Spices valued £. 4345 - 17 - 9. With Diamonds valued £. 3707 - 16. With Calicoes valued £. 2709 15 - 10. With Silks valued £. 6789 - 18. With Drugs valued £. 3576 - 18. What does the Cargo amount to? Facit £. 21638 - 4 - 7.

VIII. A Boy received for Christmas-Box, viz. Of A. 2s. 6d. of B. 1s. of C. 6d. of D. 8d. of E. 9d. of F. 1s. 3d. of G. 7s. 6d. of H. 2d. of J. 3d½. of L. 1d¾. of M. 1s. 7d. How much did he receive in all? Facit 16s. 4d¾.

IX. Paid this Week, viz. June 21st, for a Bundle of Asparagus 2s. for a Parcel from Chelsea 4s. 6d. The 22d, for cleaning the Parlour Clock, 7s. 6d. for a Dozen of Pidgeons, 4s. 6d. The 23d, Expences

IN APPLICATE NUMBERS. 63

at Islington, 7s. 6d $\frac{1}{2}$. Millener's Bill £.3 - 14 - 9 $\frac{3}{4}$. The 24th, for Peas and Beans 1s. 4d. The 25th, for Plumbs, Currants, and Gooseberries 3s. 1d $\frac{1}{2}$; for a Fowl 1s. 9d. Molly's Wages, due this Day £.1 - 15. The 26th, Butcher's Bill £.1 - 14 - 3 $\frac{1}{2}$. Baker's Bill £.1 - 9 - 10 $\frac{1}{4}$. for 2lbs. of Chocolate 8s. for 2oz. of Coffee 8d. What is the Total Expence of this Week? Facit £.10 - 11 - 10 $\frac{1}{2}$.

X. Sold this Day, viz. 376 yds. 3 qrs. 2 nails + 179 yds. 2 qrs. 3 nails + 87 yds. 2 qrs. 3 nails + 18 yds. 0 qrs. 2 nails + 300 yds. 3 qrs. 3 nails. How many Yards did I sell in all? Facit 963 yds. 1 qr. 1 nail.

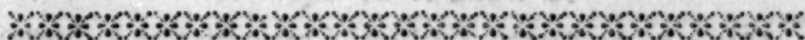
XI. Imported 3 Bags of Cotton, weighing, viz. No. I. 3 C. 1 qr. 27 lbs. No. II. 4 C. 3 qrs. 19 lbs. No. III. 3 C. 2 qrs. 4 lbs. What is the Quantity of Cotton imported? Facit 11 C. 3 qrs. 22 lbs.

XII. Entered in the Custom-House 6 Casks of Barbadoes Sugar, weighing, viz. No. I. 8 C. 3 qrs. 17 lbs. No. II. 8 C. 2 qrs. 18 lbs. No. III. 9 C. 1 qr. No. IV. 8 C. 3 qrs. 27 lbs. No. V. 8 C. 0 qr. 16 lbs. No. VI. 9 C. 3 qrs. 27 lbs. I demand the Quantity of Sugar entered? Facit 53 C. 3 qrs. 21 lbs.

XIII. A Manor contains as follows: Mr. Saunders's Farm and Lands, 41 A. 3 R. 17 P. The Common, 427 A. 1 R. 18 P. Arable Land, 47 A. 2 R. Mr. Jones's Field, 37 A. 3 R. 36 P. Meadows 57 A. 0 R. 13 P. Pasture, 49 A. 2 R. 17 P. How many Acres does this Manor contain? Facit 661 A. 1 R. 21 P.

XIV. A Shop-keeper, having opened a Shop, sold the first Day for £.15 - 13 - 7 $\frac{3}{4}$ of Goods, and thus he went on for one Week (viz. 6 Days). How much did he take in all? Facit £.94 - 1 - 10 $\frac{1}{2}$.

Set down £.15 - 13 - 7 $\frac{3}{4}$, six Times under one another. Then add.



S U B T R A C T I O N.

RULE. Work as in Whole Numbers, observing only that when, in the Applicate Numbers, a Figure in the Top or Minuend is less than that which stands under it in the Bottom or Subtrahend, you must suppose the Figure in the Top or Minuend increased of that Number of Units, for which in Addition, you should carry 1 to the preceding Denomination; that is to say, you are to suppose to the Minuend, instead of 10, as many Units more as will make one or a Whole of the next higher Denomination; and then carry 1.

Note I. To obtain, by a single Operation, the Remainder of several Sums given to be subtracted from a single Sum, follow the Rules of the second CASE in Whole Numbers; observing only that, in the Denominations, you must suppose (instead of Tens) that

that Quantity which, according to the Case, will complete one, two, three, &c. Wholes of the next greater Denomination; and then carry 1 for each Whole.

Note II. To obtain, by a single Operation, the Remainder of a single Sum given to be subtracted from several, follow the Rules of the third CASE in Whole Numbers; observing that, in the Denominations, you must find the Difference (not between Ten, but) between the Subtrahend, and as many Units as are equal to one or a Whole of the next greater Denomination; and then proceed as in Whole Numbers.

Note III. To obtain, by a single Operation, the Remainder of several Sums given to be subtracted from several Sums, follow the Rules of the fourth CASE in Whole Numbers; observing that, in the Denominations, you must always come up (not to the next Ten, but) to the next Quantity which will complete one, two, three, &c. Wholes of the next greater Denomination; and then proceed as in Whole Numbers.

PROOF. As in Integers.

EXAMPLE IN MONEY.

Borrowed of a Friend	£. 354 - 17 - 5 $\frac{1}{4}$	Minuend.	
Paid him . . .	159 - 18 - 6 $\frac{3}{4}$	Subtra.	PROOF.
Remains due . .	194 - 18 - 10 $\frac{1}{2}$	Rem.	354 - 17 - 5 $\frac{1}{4}$

ILLUSTRATION.

TO WORK IT BY ADDITION.

I begin by the Row of *Farthings*: $\frac{1}{4}$ being less than $\frac{3}{4}$, I suppose 4 Farthings more to the Minuend $\frac{1}{4}$ (as 4 Farthings = 1 *d* or a Whole of the next higher Denomination); then I consider the Minuend as 5, and therefore say, 3 (*Subtrahend*) + 2, to write down in the Remainder, = 5 Farthings, or $\frac{1}{4}$ in the Minuend, and 1 *d* to carry.

At the Row of *Pence*: 1, that I carry, + 6 (*Subtrahend*) = 7 + 10, to write in the Remainder (it being the Difference to 17, supposing the Minuend increased of 12 *d* or 1 *s*), next higher Denomination) = 17 Pence, or 5 *d* in the Minuend, and 1 *s* to carry.

At the Column of *Shillings*: 1, that I carry, + 18 (*Subtrahend*) = 19 + 18, to write in the Remainder (it being the Difference to 37, supposing the Minuend increased of 20 *s* or £. 1, next higher Denomination) = 37 Shillings, or 17 *s* in the Minuend, and £. 1 to carry.

Now that I am come to *Pounds*, I proceed as in Whole Numbers, thus: At the Column of *Units of Pounds*: 1, that I carry, + 9

= 10

IN APPLICATE NUMBERS. 65

= 10 + 4, to write in the Remainder = 4 in the Minuend and 1 Ten, to carry.

At the Column of *Tens of Pounds*: 1, that I carry, + 5 = 6 + 9, to write in the Remainder = 5 in the Minuend and 1 Ten, to carry.

At the Column of *Hundreds*: 1, that I carry, + 1 = 2 + 1, to write in the Remainder, = 3 in the Minuend.

OTHER EXAMPLES IN MONEY.

Borrowed	£. 754 - 6 - 7 $\frac{1}{4}$	62 - 18 - 10 $\frac{1}{4}$	1 - 8 - 8 $\frac{3}{4}$
Paid . . .	608 - 17 - 9 $\frac{3}{4}$	34 - 19 - 11 $\frac{3}{4}$	0 - 8 - 8 $\frac{3}{4}$

Rem. to Pay	145 - 8 - 9 $\frac{3}{4}$	27 - 18 - 10 $\frac{3}{4}$	0 - 19 - 11 $\frac{1}{2}$
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Lent . . .	£. 4700 - 0 - 0	87 - 5 - 6 $\frac{3}{4}$	47 - 9 - 10 $\frac{1}{4}$
Received . .	384 - 8 - 7 $\frac{1}{4}$	9 - 16 - 7	18 - 10 - 7 $\frac{1}{4}$

Rem. to receive	4315 - 11 - 4 $\frac{3}{4}$	77 - 8 - 11 $\frac{1}{4}$	28 - 19 - 3 $\frac{1}{4}$
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Borrowed	£. 4546 - 4 - 9 $\frac{3}{4}$	Lent	£. 31257 - 17 - 1 $\frac{3}{4}$
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Paid at different Times.	874 - 2 - 5 $\frac{1}{4}$ 346 - 4 - 9 $\frac{3}{4}$ 1645 - 17 - 6 $\frac{1}{4}$ 454 - 3 - 9 $\frac{3}{4}$ 675 - 4 - 3 $\frac{1}{4}$	Received at different Times.	2422 - 18 - 11 $\frac{1}{4}$ 3278 - 18 - 5 $\frac{3}{4}$ 2422 - 18 - 11 $\frac{1}{4}$ 4689 - 17 - 6 $\frac{1}{4}$ 8978 - 4 - 3 $\frac{3}{4}$
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Remains due	550 - 11 - 11 $\frac{1}{2}$	Rem. to receive	8764 - 18 - 11 $\frac{1}{2}$
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Borrowed	£. 145 - 17 - 9 $\frac{1}{4}$	Lent	£. 394 - 5 - 6 $\frac{3}{4}$
at	342 - 14 - 8 $\frac{3}{4}$	at	454 - 12 - 4 $\frac{1}{4}$
different	129 - 19 - 11 $\frac{1}{2}$	different	98 - 17 - 5 $\frac{1}{4}$
Times.	354 - 4 - 9 $\frac{3}{4}$	Times.	79 - 5 - 7 $\frac{3}{4}$

Paid	499 - 15 - 5 $\frac{1}{2}$	Received	758 - 17 - 6 $\frac{3}{4}$
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Rem. due	473 - 1 - 9 $\frac{1}{4}$	Rem. due	268 - 3 - 5 $\frac{1}{2}$
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Borrowed	£. 54 - 19 - 9	Lent	£. 454 - 17 - 6 $\frac{3}{4}$
at	36 - 14 - 6	at	384 - 19 - 7 $\frac{1}{4}$
different Times.	42 - 19 - 9	different Times.	870 - 14 - 9

Paid at different Times.	36 - 14 - 3 24 - 16 - 9 16 - 13 - 3	Received at different Times.	804 - 16 - 3 $\frac{1}{4}$ 703 - 14 - 5 102 - 10 - 7 $\frac{3}{4}$
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Remains due	56 - 9 - 9	Remains due	99 - 10 - 7 $\frac{1}{4}$
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OTHER,

OTHER EXAMPLES IN WEIGHTS AND MEASURES.

<i>lbs. oz. dwts. gr.</i>		<i>t. cts. qrs. lbs. oz. dr.</i>	
84 - 7 - 8 - 18 <i>Troy</i>		54 - 15 - 2 - 21 - 8 - 9 <i>Avoir du</i>	
36 - 9 - 11 - 22 <i>Weight.</i>		6 - 18 - 2 - 25 - 9 - 11 <i>Poids</i>	
			<i>Weight.</i>
47 - 9 - 16 - 20		47 - 16 - 3 - 23 - 14 - 14	
<u>3 3 9 gr.</u>		<u>qrs. bu. p.</u>	<u>cb. bu. p.</u>
27 - 1 - 0 - 1 <i>Apothecaries</i>		75 - 3 - 2	79 - 3 - 0
15 - 2 - 0 - 7 <i>Weight.</i>		37 - 7 - 3	54 - 7 - 1
11 - 6 - 2 - 14		37 - 3 - 3	24 - 31 - 3
<u>yds. qrs. na.</u>		<u>el. qrs. na. bds. gal. grt.</u>	
8 - 3 - 2		4 - 3 - 2	75 - 57 - 1 <i>Wine</i>
7 - 3 - 3		1 - 4 - 3	57 - 59 - 2 <i>Measure.</i>
0 - 3 - 3		2 - 3 - 3	17 - 60 - 2
<u>a. b. fir. gal.</u>		<u>b. b. fir. gal.</u>	<u>a. r. p.</u>
25 - 1 - 2 <i>Ale</i>		37 - 2 - 1 <i>Beer</i>	75 - 1 - 7 <i>Land</i>
21 - 1 - 5 <i>Measure.</i>		25 - 1 - 7 <i>Measure.</i>	39 - 0 - 27 <i>Measure.</i>
3 - 3 - 5		12 - 0 - 3	36 - 0 - 20
<u>yds. f. in.</u>		<u>m. fur. p.</u>	
24 - 1 - 10		8 - 6 - 35	
15 - 2 - 11		4 - 7 - 37	
9 - 1 - 11		3 - 6 - 38	
<u>sq. yds. f. in.</u>		<u>b. p. "</u>	<u>d. b.</u>
36 - 6 - 66 <i>Square</i>		48 - 8 - 9	68 - 21 - 26
24 - 7 - 100 <i>Measure.</i>		19 - 41 - 52	38 - 23 - 45
11 - 7 - 110		26 - 82 - 17	29 - 21 - 49

QUESTIONS TO EXERCISE THE LEARNER.

- I. If I borrow of a Man £. 2000, and pay him again £. 362 - 17 - 7 $\frac{1}{2}$: what am I yet indebted to him? Facit £. 1637 - 2 - 4 $\frac{1}{2}$.
- II. What Sum of Money must I add to £. 58 - 14 - 6 $\frac{3}{4}$, to make it up £. 100? Facit £. 41 - 5 - 5 $\frac{1}{4}$.

III. What

IN APPLICATE NUMBERS. 67

III. What Sum must I take out of £. 100, to have the Remainder £. 41 - 5 - 5 $\frac{1}{4}$? Facit £. 58 - 14 - 6 $\frac{3}{4}$.

IV. Remitted to may Banker £. 1000. And, drawn upon him, Jan. 3, £. 17 - 11 - 10 $\frac{1}{2}$; the 14th, £. 9 - 9 - 11 $\frac{1}{4}$; Feb. 8, £. 8 - 18 - 9 $\frac{1}{4}$; March 14, £. 9 - 13 - 10 $\frac{3}{4}$: How much has he still in his Hands belonging to me? Facit £. 954 - 5 - 6 $\frac{1}{4}$.

V. Borrowed of Simon Cruel, Usurer, viz. Once, £. 504 - 15. —Another Time, £. 1642 - 0 - 10. —Another Time, £. 60 - 0 - 4 $\frac{1}{2}$. —Another Time, £. 17 - 15 - 7. —And, another Time, £. 666 - 5 - 4 $\frac{3}{4}$. —If I sell him an Estate worth £. 6599 - 19 - 11 $\frac{1}{4}$, what will he be indebted to me? Facit £. 3709 - 2 - 9 $\frac{1}{2}$.

VI. I owe to A, £. 406 - 19 - 4 $\frac{3}{4}$; to B, £. 306 - 14 - 7 $\frac{1}{2}$; to C, £. 9 - 4 - 5 $\frac{1}{2}$; to D, £. 8 - 16 - 11; to E, £. 109 - 7 - 10; And, I have in Cash only £. 64 - 5 - 6: how much must I borrow to be able to pay all my Debts? Facit £. 226 - 17 - 8 $\frac{3}{4}$.

VIII. Bought last Week 42 Hogsheads of Wine, which cost me, Charges included, £. 312 - 12 - 5 $\frac{1}{2}$; and sold the Whole, viz. To A, 3 Hhds. for £. 21 - 14 - 9. To B, 4 Hhds. for £. 36 - 18 - 2. To C, 2 Hhds. for £. 14 - 17 - 9. To D, 12 Hhds. for £. 91 - 14 - 6. To E, 9 Hhds. for £. 71 - 12 - 8. To F, 10 Hhds. for £. 83 - 16 - 7. To G, 2 Hhds. for £. 14 - 14 - 2. How much did I clear upon the Wine? Facit £. 22 - 16 - 1 $\frac{1}{2}$.

VIII. Cash Dr.

Contra Cr.

£.	s.	d.	£.	s.	d.
To John Bell	714	- 16 - 7 $\frac{1}{4}$	By Henry Brown	54	- 16 - 7 $\frac{1}{4}$
Irish Linen	68	- 14 - 6	By James Fell	98	- 17 - 10 $\frac{1}{4}$
Brandy	9	- 7 - 8	By Peter Fair	256	- 8 - 4 $\frac{1}{4}$
House Expences	47	- 10 - 10 $\frac{3}{4}$	By John Good	86	- 19 - 11 $\frac{1}{4}$
Profit and Loss	28	- 18 - 11 $\frac{1}{4}$	Profit and Loss	15	- 7 - 6

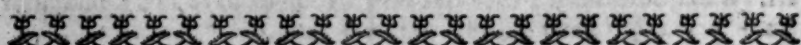
What is the Balance of this Account? Facit 356 - 18 - 3 $\frac{1}{4}$.

IX. A Merchant receives from on Board a Ship, 41 Tuns and 1 Hoghead of Claret. To A, he sells 7 Tuns 3 Hhds.: to B, 6 Tuns 3 Hhds. to C, 5 Tuns 2 Hhds. How much of the said Wine is there remaining in the Merchant's Cellar? Facit 21 Tuns and 1 Hhd.

X. A Woollen Draper buys 2564 Yards of Cloth; and sells again 1649 Yards and 3 Quarters. What remains unfold? Facit 914 Yards 1 Quarter.

XI. A Grocer buys 95 cts. 3 grs. and 9 lbs. of Currants; and sells out 49 cts. 2 grs. and 27 lbs. What Quantity remains unfold? Facit 46 cts. 0 grs. 10 lbs.

XII. A Gentleman delivered to a Silversmith 2 lbs. 5 oz. 11 dwts. of Silver; and he received a Silver-cup, which weighed 11 oz. 14 dwts; and at another Time six large Spoons, weighing 1 lb. 2 oz. 3 dwts. 14 grs. What weight of Silver has the Silversmith still in his Hands? Facit 3 oz. 13 dwts. 10 grs.



MULTIPLICATION.

CASE I. The Multiplier not exceeding 13.

RULE. Begin to multiply the lowest Denomination in the Price, or Quantity consisting of several Denominations, by the other Quantity (*Multiplier*); divide the Product, as in Addition, by as many of that, as will equal a Whole of the next superior Denomination; set down the Remainder under that lowest Denomination, and carry the Quotient in Mind, to join it to the next, after it is multiplied. Thus, proceed throughout the Whole Operation.

The **PROOF** is properly done by Division: but as we are not yet come to that Chapter of Applicate Numbers, so, for the present, this Rule will answer the Purpose.—Double the Price or Quantity consisting of several Denominations, and take the Half of the other Quantity; then make another Multiplication, observing that, if, in taking the Half of the Quantity, there is $\frac{1}{2}$ over at last, you must join to the other Product the Price of the first Operation.

EXAMPLES.

I. What cost 5 Pieces of Cloth at £.4 - 19 - 10 per Piece?
Facit £.24 - 19 - 2.

PROOF.

£. 4 - 19 - 10	The Double of the Piece =	9 - 19 - 8
5	The Half of the 5 Pieces =	2 + $\frac{1}{2}$
24 - 19 - 2	For the $\frac{1}{2}$, add the 1st Piece	19 - 19 - 4
		4 - 19 - 10
	Same Product	24 - 19 - 2

ILLUSTRATION.

In the above Example, Pence being the lowest Denomination, I begin to multiply them by the Quantity (5 Pieces), and say: 1st, 5 Times 10 Pence are 50: then, by Division, in 50 Pence, how many Shillings, or, how many Times 12 (because there are 12 Pence in a Shilling); and finding it goes 4 Times and 2 over, I set down the 2, that are over, under the Pence, and carry 4 in Mind to be joined to the Product that I shall find in the Shillings.—adly, 5 Times 19 Shillings are 95, and 4 that I carry are 99: then, by

IN APPLICATE NUMBERS. 69

by Division, in 99 Shillings, how many Pounds, or, divide 99 by 20 (because there are 20 Shillings in a Pound); and finding that it goes, or the Quotient is, 4 and 19 over, I set down the 19 over, under the Shillings, and carry 4 in Mind*. 3dly, 5 Times 4 Pounds are 20, and 4 that I carry are 24, which, as there is no other Figure to multiply, I set down in full.—Thus I find, that if one Piece of Cloth cost £.4 - 19 - 10, the 5 will cost £.24 - 19 - 2, which to prove: I double the Price £.4 - 19 - 10; and thus, have £.9 - 19 - 8, for new Multiplicand; and taking the Half of the Quantity (5 Pieces), I have $2\frac{1}{2}$, for new Multiplier: Then, multiplying £.9 - 19 - 8 by 2, I have the Product £.19 - 19 - 4, to which joining, for the $\frac{1}{2}$ over, £.4 - 19 - 10, given Price in the Question, I have the same Product as that found by the first Operation, viz. £.24 - 19 - 2.

II. If 1 *cwt.* of Ship-Biscuit cost 14s. 7d. $\frac{1}{2}$; what will 6 *cwts.* come to? Facit £.4 - 7 - 9.

£.0 - 14 - 7 $\frac{1}{2}$ 6	PROOF. The Double of the Price = £.1 - 9 - 3 The Half of the Quantity = 3
4 - 7 - 9	Same Product . . . 4 - 7 - 9

OTHER EXAMPLES IN MONEY.

£.0 - 7 - 5 $\frac{1}{4}$ 7	£.0 - 4 - 2 8	£.0 - 6 - 7 11	£.1 - 5 - 4 10
2 - 12 - 0 $\frac{3}{4}$	1 - 13 - 4	3 - 12 - 5	12 - 13 - 4
£.1 - 13 - 7 10	£.0 - 11 - 6 12	£.3 - 14 - 5 11	£.6 - 14 - 7 $\frac{1}{2}$ 9
16 - 15 - 10	6 - 18 - 0	40 - 18 - 7	60 - 11 - 7 $\frac{1}{2}$

OTHER EXAMPLES IN WEIGHTS AND MEASURES.

lbs. oz. dwts. grs.	cts. gr. lbs.	lbs. oz. dr.
14 - 5 - 10 - 8 5 <i>Troy</i> Weight.	16 - 1 - 13 8 130 - 3 - 20	18 - 9 - 15 7 130 - 5 - 9
86 - 9 - 2 - 0	<i>Avoir</i> <i>du</i> <i>Poids</i> <i>Weight.</i>	<i>Avoir</i> <i>du</i> <i>Poids</i> <i>Weight.</i>

* In the practical Way, I should, in Shillings, multiply first the Units 9 by 5; and the Product being 45, I should set down 5 and carry 4 in Mind. 2dly, the 1 Ten of Shillings by 5, and to the Product 5 joining the 4 that I carry, I should have 9 Tens; then because 9 is an odd Number, I should set down 1 of those Tens under the Row of Tens of Shillings, and therefore 8 Tens only should remain, the half of which being 4, I should carry 4 to the Pounds.—This is according to what has been observed in Addition about Shillings, and is certainly the easiest Way.

70 MULTIPLICATION

a. r. p.	a. b. fir. gal.	b. b. fir. gal.
75 - 2 - 1	32 - 1 - 7	26 - 2 - 7
9 Land	7 Ale	3 Beer
Meas.	Measure.	Meas.
679 - 2 - 9	227 - 1 - 1	80 - 0 - 3

Note. When the Multiplier is fractional, see the Note after the first CASE of Division, next Chapter.

CASE II. The Multiplier containing common Multiples or nearly.

RULE. If the Multiplier, that is, the Quantity given, can be divided just in common Multiples, multiply the Price or Quantity consisting of several Denominations by one of the common Multiples, as in last CASE; then successively the Products by the next common Multiple (see CASE VI. in Whole Numbers).—But, if the Multiplier can not be divided just in common Multiples, seek for common Multiples, which will come the nearest to the Quantity, but not exceed it. Work with these common Multiples as aforesaid, then add the Price as many Times as there are odd Units over the common Multiples.

PROOF. As by last CASE. Or else, by another Multiplication: for which Purpose, begin to multiply by the common Multiple, which, in the first Operation, was the last; then by that common Multiple which was next to the last, and so on.

For more Ease, learn to repeat the following Table:

14 = 2 X 7 *	44 = 4 X 11	84 = 7 X 12
15 = 3 X 5	45 = 5 X 9	88 = 8 X 11
16 = 2 X 8	48 = 6 X 8	90 = 9 X 10
18 = 2 X 9	49 = 7 X 7	91 = 7 X 13
20 = 2 X 10	50 = 5 X 10	96 = 8 X 12
21 = 3 X 7	52 = 4 X 13	99 = 9 X 11
22 = 2 X 11	54 = 6 X 9	100 = 10 X 10
24 = 3 X 8	55 = 5 X 11	104 = 8 X 13
25 = 5 X 5	56 = 7 X 8	108 = 9 X 12
26 = 2 X 13	60 = 10 X 6	110 = 11 X 10
27 = 3 X 9	63 = 7 X 9	117 = 9 X 13
28 = 4 X 7	64 = 8 X 8	120 = 10 X 12
30 = 3 X 10	65 = 5 X 13	130 = 10 X 13
32 = 4 X 8	66 = 6 X 11	132 = 11 X 12
33 = 3 X 11	70 = 7 X 10	143 = 11 X 13
35 = 5 X 7	72 = 8 X 9	144 = 12 X 12
36 = 4 X 9	77 = 7 X 11	156 = 12 X 13
39 = 3 X 13	78 = 6 X 13	169 = 13 X 13
40 = 4 X 10	80 = 8 X 10	
42 = 6 X 7	81 = 9 X 9	

* Read 14 equal 2 multiplied by 7, &c.

IN APPLICATE NUMBERS. 71

75 = 3 × 5 × 5	294 = 7 × 7 × 6
125 = 5 × 5 × 5	324 = 4 × 9 × 9
128 = 4 × 4 × 8	343 = 7 × 7 × 7
147 = 7 × 7 × 3	375 = 3 × 5 × 5 × 5
175 = 7 × 5 × 5	384 = 8 × 8 × 6
180 = 5 × 6 × 6	500 = 4 × 4 × 5 × 5
196 = 7 × 7 × 4	512 = 8 × 8 × 8
216 = 6 × 6 × 6	729 = 9 × 9 × 9
243 = 3 × 9 × 9	1000 = 10 × 10 × 10

EXAMPLES.

I. What cost 35 Yards of Holland at 4s. 5d. $\frac{1}{4}$ per Yard?

Facit £. 7 - 15 - 3 $\frac{3}{4}$.

As 5 × 7 } = 35, so £. 0 - 4 - 5 $\frac{1}{4}$ or £. 0 - 4 - 5 $\frac{1}{4}$
 or 7 × 5 } 5 7

Product of 5 Yards £. 1 - 2 - 2 $\frac{1}{4}$ £. 1 - 11 - 0 $\frac{3}{4}$ = 7 Ys.
 7 5

Product of 35 Yds. £. 7 - 15 - 3 $\frac{3}{4}$ £. 7 - 15 - 3 $\frac{3}{4}$ = 35

In the above Example, I consider which Numbers, being multiplied together, would make 35 (Quantity of Yards), and find that 5 Times 7 make 35, as do likewise 7 Times 5. Therefore, I multiply the Price £. 0 - 4 - 5 $\frac{1}{4}$ by 5, and get £. 1 - 2 - 2 $\frac{1}{4}$, which multiplied by 7 give £. 7 - 15 - 3 $\frac{3}{4}$ Product required. Or else I multiply £. 0 - 4 - 5 $\frac{1}{4}$ first by 7, and get £. 1 - 11 - 0 $\frac{3}{4}$, which multiplied by 5 give the same Product £. 7 - 15 - 3 $\frac{3}{4}$. And these two Ways may serve for Proof to one another.

II. What cost 58 Pieces of Cloth at £. 4 - 6 - 3 $\frac{1}{2}$ per Piece?

Facit £. 250 - 9 - 9.

As 7 × 8 + 2 } = 58, so £. 4 - 6 - 4 $\frac{1}{2}$
 or 8 × 7 + 2 } 7
 7 Pieces cost . £. 30 - 4 - 7 $\frac{1}{2}$
 8

Price of 56 Pieces . . . 241 - 17 - 0
 £. 4 - 6 - 4 $\frac{1}{2}$ × 2, for 2 over = 8 - 12 - 9

The 58 cost £. 250 - 9 - 9

N. B. When the Multiplier consists of a great Number, wherein common Multiples can not be found, multiply the Price, or Quantity consisting of several Denominations, by as many Tens as the Multiplier consists of Places, save one, the last Product by

by the first Figure on the Left-Hand, the next in order by the succeeding Place, &c. which is according to Note II. CASE IV. in Whole Numbers.

EXAMPLE.

What cost 1945 at £. 66 - 5 - 7 one?	Facit 128912 - 19 - 7
1st, Multiply by	£. 66 - 5 - 7 10
2dly, Multiply by	£. 662 - 15 - 10 10
3dly, Multiply by	£. 6627 - 18 - 4 10
	66279 - 3 - 4
Product of 1000.	
£. 6627 - 18 - 4 } Product of 100	× 9 = 59651 - 5 - 0
Product of 900.	
£. 662 - 15 - 10 } Product of 10	× 4 = 2651 - 3 - 4
Product of 40.	
£. 66 - 5 - 7 } Price of 1	× 5 = 331 - 7 - 11
Product of 5.	
	128912 - 19 - 9
Prod. of 1945.	

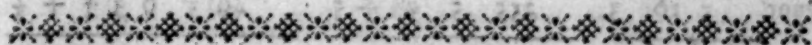
QUESTIONS TO EXERCISE THE LEARNER.

- I. What will 43 Hhds. of Port Wine come to, at £. 6 - 5 - 11 per Hhd.? Facit 270 - 14 - 5.
- II. What is the Total of 63 Years Rent, at £. 34 - 19 - 11 per annum? Facit £. 2204 - 14 - 9.
- III. At £. 8 - 17 - 6 a Thing, what will 146 come to? Facit £. 1295 - 15.
- IV. 36 Chaldrons of Coals, at £. 1 - 11 - 6 per Chaldron? Facit £. 56 - 14.
- V. 109 Pieces of Holland, at £. 2 - 4 - 7 per Piece? Facit £. 242 - 19 - 7.
- VI. 96 Quartern Loaves, at 5 $\frac{3}{4}$ d each? Facit £. 2 - 6.
- VII. 55 Days, at 3s. 5 $\frac{1}{4}$ d. every Day? Facit £. 9 - 9 - 0 $\frac{3}{4}$.
- VIII. 60 Sheep, at £. 1 - 15 - 7 each? Facit £. 106 - 15.
- IX. 75 Ells of Cloth, at 17s. 4 $\frac{3}{4}$ d? Facit £. 65 - 4 - 8 $\frac{1}{4}$.
- X. 72 Loads, at £. 3 - 10 - 6 a Load? Facit £. 253 - 16.
- XI. 81 Hats, at 16s. 3 $\frac{1}{4}$ d. a Hat? Facit £. 65 - 17 - 11 $\frac{1}{4}$.
- XII. 34 Grofs of Corks, at 10s. 6 $\frac{1}{2}$ d per Grofs? Facit £. 17 - 18 - 5.

XIII. 48

IN APPLICATE NUMBERS. 73

- XIII. 48 Pair of Shoes, at 4s. 2 $\frac{3}{4}$ d. each? Facit £. 10 - 3.
 XIV. 122 lbs. of Nutmegs, at 7s. 2 $\frac{3}{4}$ d. per lb. Facit £. 44 - 1 - 11 $\frac{1}{2}$.
 XV. What is the Value of 684 Hhds. of Wine, at £. 8 - 9 - 7 $\frac{1}{2}$ per Hhd? Facit £. 5801 - 3 - 6.
 XVI. Bought 574 lbs. of Tobacco, at 7 $\frac{3}{4}$ d. per lb. Facit £. 18 - 10 - 8 $\frac{1}{2}$.
 XVII. Sold 378 Pieces of Cloth, at £. 7 - 16 - 11. per Piece. Facit £. 2965 - 14 - 6.
 XVIII. Bought 174 Ingots of Silver, each Ingot weighing 15 lbs. 11 oz. 19 dwts. 21 grs. What is the Weight of the Whole? Facit 2783 lbs. 10 oz. 18 dwts. 6 grs.



DIVISION.

CASE I. The Divisor not exceeding 13.

RULE. Divide the first Denomination on the Left Hand, by the Quantity given: write down the Quotient under it; and if any Thing remains, multiply it by as many of the next inferior, as make a Whole of that; add the Product to the next, and divide as before. Thus proceed throughout all the Denominations.

PROOF. Multiply the Quotient by the Divisor; and if the Product comes the same as the Dividend, the Operation is right.

EXAMPLE IN MONEY.

The Sum of £. 10 - 14 - 1. is to be divided between 4 Persons: What will each have? Facit £. 2 - 13 - 6 $\frac{1}{2}$.

$\begin{array}{r} 4 \overline{) 10 - 14 - 2} \\ \text{Quotient } 2 - 13 - 6\frac{1}{2} \end{array}$	$\begin{array}{r} \text{PROOF. } \left\{ \begin{array}{l} 2 - 13 - 6\frac{1}{2} \\ \hline 4 \end{array} \right. \\ \hline 10 - 14 - 2 \end{array}$
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ILLUSTRATION.

In the above Example, the Divisor being 4, I say: In 10 Pounds, how many Times 4? and finding it goes twice and 2 over, I set down 2 in the Quotient. Then, the 2 Pounds over multiplying by 20, because 20 Shillings (next inferior Denomination) make 1 Pound, I have 40s. to which joining the 14s. in the Dividend, the new Dividual is 54s. Therefore, I say, In 54s. how many Times 4? And finding it goes 13 Times, and 2 over, I set down in the Quotient 13. Then, the 2 Shillings over multiplying by 12, because 12 Pence (next inferior Denomination) make 1 Shilling, I have 24d.

L

10

to which joining the *2d.* in the Dividend, the new Dividual is *26d.* Therefore, I say, In *26d.* how many Times *4^{d.}* and finding it goes 6 Times, and 2 over, I set down 6 in the Quotient. Then, the *2d.* over multiplying by 4, because 4 Farthings (next inferior Denomination) make *1d.* I have 8 for new Dividual. Therefore, I say: In 8 Farthings, how many Times *4^{d.}* and finding it goes twice, I set down 2 Farthings (that is, $\frac{2}{4}$) in the Quotient.

OTHER EXAMPLES IN MONEY.

	£. S. D.		£. S. D.		£. S. D.
6)	34 17 6	3)	765 17 5 $\frac{3}{4}$	8)	39467 14 5 $\frac{3}{4}$
Quot.	5 16 3		255 5 9 $\frac{3}{4}$ + $\frac{3}{4}$		4933 9 3 $\frac{1}{2}$ + $\frac{1}{2}$
11)	3846 13 7	7)	1946 18 4 $\frac{1}{2}$	12)	4869 17 6
Quot.	349 13 11 $\frac{1}{2}$ + $\frac{3}{4}$		278 2 7 $\frac{1}{2}$		405 16 5 $\frac{1}{2}$

OTHER EXAMPLES IN WEIGHTS AND MEASURES.

	lbs. oz. dwts. gr.		Cts. qrs. lbs.
6)	86 9 2 0 Troy.	8)	130 3 20 Avoir du Poids.
Quot.	14 5 10 8		16 1 13
	lbs. oz. dr.		lb. 3. 3. 3. gr.
7)	130 5 9 Avoir du	12)	70 6 4 2 8 Apothecaries
Quot.	18 9 15 Poids.		5 10 4 1 4 Weight.
	m. fur. p.		yds. feet. in.
4)	58 1 36 Long Measure.	10)	157 1 6 Long Measure.
Quot.	14 4 19		15 2 3
	A.B. fir. gal.		B.B. fir. gal.
7)	227 1 1 Ale Measure.	3)	80 0 3 Beer Measure.
Quot.	32 1 7		26 2 7

Here may be observed, that when, in Multiplication, the Multiplier is fractional; that is, when there is $\frac{1}{2}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{1}{3}$, $\frac{2}{5}$, &c. annexed to the Quantity of Things bought, sold, &c. after having multiplied the Price or Quantity, consisting of several Denominations, by the whole Numbers of the Multiplier, you must divide the Price or Quantity of several Denominations by the Denominator of the Fraction, whose Quotient afterwards add to the Products of the Whole Numbers as often as there are Units in the Numerator.

If the Quantity to be multiplied is fractional, you must multiply the Numerator by the Multiplier; then divide the Product by the Denominator: the Quotient of this Division is what you are to carry in

IN APPLICATE NUMBERS. 75

in Mind, to be added to the Product of the next Denomination; and the Remainder, if any, is what you are to write in the Product.

N. B. Fractions are reduced to lower Denominations, by taking, in the Numerator, such Part or Parts as may be likewise taken in the Denominator, as in Rule of Three by Contraction.

EXAMPLE.

Sold $8\frac{1}{2}$ Barrels of Herrings, at £. 3 - 16 - 6 per B. Facit £. 33 - 15 - 9.

$$\begin{array}{r} 3 - 16 - 6 \\ \quad 8 \\ \hline 30 - 12 - 0 \\ 0 - 12 - 9 \text{ for } \frac{1}{8} \\ 2 - 11 - 0 \text{ for } \frac{1}{8} \end{array} \quad \left. \begin{array}{l} \text{£. } 3 - 16 - 6 \div 6 = \\ 12\text{s. } 9\text{d. Prod. of } \frac{1}{8} \times 4 = \end{array} \right\} = \frac{1}{8}$$

$$33 - 15 - 9$$

CASE II. The Divisor containing common Multiples.

RULE. Divide, as in last Case, by one of the common Multiples; then by the next. See CASE IV. in *Whole Numbers*.

PROOF. By Multiplication, as in the last Case; or, divide reversely by the common Multiple which in the 1st Operation was the last, then by that common Multiple which was next to the last; and so on.

EXAMPLES.

I. Bought 32 Pieces of Cloth for £. 85 - 12 - 8. What does a Piece come to? Facit £. 2 - 13 - 6 $\frac{1}{4}$.

$$\begin{array}{l} \text{As } 4 \times 8 \\ \text{or } 8 \times 4 \end{array} \left. \vphantom{\begin{array}{l} \text{As } 4 \times 8 \\ \text{or } 8 \times 4 \end{array}} \right\} = 32, \text{ So } \begin{array}{l} 4) 85 - 12 - 8 \\ 8) 21 - 8 - 2 \\ 2 - 13 - 6\frac{1}{4} \end{array} \quad \begin{array}{l} \text{Or } 8) 85 - 12 - 8 \\ 4) 10 - 14 - 1 \\ 2 - 13 - 6\frac{1}{4} \end{array} \quad \text{Ans.}$$

II. Divide £. 487 - 17 - 6. into 54 Shares. Facit £. 9 - 0 - 8 $\frac{1}{3}$ + $\frac{18}{54}$ or $\frac{1}{3}$.

$$\begin{array}{l} \text{As } 6 \times 9 \\ \text{or } 9 \times 6 \end{array} \left. \vphantom{\begin{array}{l} \text{As } 6 \times 9 \\ \text{or } 9 \times 6 \end{array}} \right\} = 54, \text{ So } \begin{array}{l} 6) 487 - 17 - 6 \\ 9) 81 - 6 - 3 \\ 9 - 0 - 8\frac{1}{3} + \frac{18}{54} \end{array} \quad \begin{array}{l} \text{Or } 9) 487 - 17 - 6 \\ 6) 54 - 4 - 2 \\ 9 - 0 - 8\frac{1}{3} + \frac{18}{54} \end{array}$$

III. A Prize of £. 7257 - 3 - 6 is to be equally divided amongst 500 Sailors: What is each Man's Share? Facit £. 14 - 10 - 3 $\frac{1}{4}$ +.

$$\begin{array}{l} \text{As } 5 \times 5 \times 4 \times 5 = 500, \text{ So, } \end{array} \begin{array}{l} 5) 7257 - 3 - 6 \\ 5) 1451 - 8 - 8\frac{1}{5} + \\ 4) 290 - 5 - 8\frac{1}{4} + \\ 5) 72 - 11 - 5 + \\ 14 - 10 - 3\frac{1}{4} + \end{array} \left. \vphantom{\begin{array}{l} 5) 7257 - 3 - 6 \\ 5) 1451 - 8 - 8\frac{1}{5} + \\ 4) 290 - 5 - 8\frac{1}{4} + \\ 5) 72 - 11 - 5 + \\ 14 - 10 - 3\frac{1}{4} + \end{array}} \right\} \begin{array}{l} \text{the few trifling} \\ \text{Fractions I} \\ \text{don't mind.} \end{array}$$

CASE III. When the Divisor can not be divided in common Multiples.

RULE. After having divided the Integers as in Whole Numbers, multiply the Remainder, as in the last Cases, by as many of the next lower Denomination as will equal one of the Integers; divide the Product as before; and multiply the Remainder by as many of the next lower Denomination as will equal one of the first: thus proceed throughout the Whole.

PROOF. By Multiplication, as in CASE I.

EXAMPLES.

I. Suppose that the Sum of £. 39468 is to be shared equally amongst 434 Men: What is each Man to receive? Facit £. 90 - 18 - 9½ + ¾.

434)39468(90-18-9½+212, nearly ½ of a Farth.
 Remaining Pounds - - 408
 which, to have Shil. X - 20 As 20s. make 1 Pound.

8160
 3820
 Remaining Shillings - - 348
 which, to have d. X - 12 As 12d. make 1s,

4176
 270
 Remaining Pence - - 270
 which, to have Farth. X - 4 As 4 Farthings make 1d.

1080
 212
 Remaining Farthings - - 212

II. Bought 347 Pieces of Damask, for £. 5803 - 11 - 6. How much is it per Piece? Facit £. 16 - 14 - 6.

347)5803-11-6(16-14-6
 2333
 Remaining £. - - 251
 Multiply by - - 20s. taking in the 11s. of the Dividend.

5031
 1561
 Remaining Shillings - 173
 Multiply by - - 12d. taking in the 6d. of the Dividend.

2082
 000

IN APPLICATE NUMBERS. 77

QUESTIONS TO EXERCISE THE LEARNER.

I. If a Man spends £. 257 - 2 - 5. in 12 Months Time, What is that *per Month*? Facit £. 21 - 8 - $6\frac{1}{4} + \frac{3}{12}$.

II. If I give £. 37 - 6 - $4\frac{3}{4}$. for 9 Pieces of Cloth, How much does a Piece come to? Facit £. 4 - 2 - $11\frac{1}{2} + \frac{7}{9}$.

III. What cost $6\frac{3}{4}$ Cwt. of Cheese, at £. 1 - 4 - 7. *per Cwt.* Facit £. 8 - 5 - $11\frac{1}{4}$.

IV. What cost $12\frac{1}{2}$ lbs. of Nutmegs, at 7s. $3\frac{1}{4}$ d. *per lb.* Facit £. 4 - 10 - $10\frac{1}{2} + \frac{1}{2}$.

V. What cost $9\frac{2}{3}$ Gross of Corks, at 11s. 6d. *per Gross*? Facit £. 5 - 11 - 2.

VI. At 12s. 6d. *any Thing*, What will $42\frac{2}{3}$ come to? Facit £. 26 - 10.

VII. At £. 2 - 17 - 3 *one*, What will $45\frac{1}{2}$ cost? Facit £. 131 3 - $11\frac{1}{2}$.

VIII. Divide £. 3945 among 48 Persons. Facit £. 82 - 3 - 9.

IX. £. 756 - 14 - 6. are to be shared among 216 Persons. *Each will have* £. 3 - 10 - $0\frac{3}{4}$.

X. 96 Quartern Loaves cost £. 2 - 6: What is it *per Loaf*? Facit $5\frac{3}{4}$ d.

XI. 81 Yards of Cloth cost £. 65 - 17 - $11\frac{1}{4}$: What does a Yard come to? Facit 16s. $3\frac{1}{4}$ d.

XII. If 36 Chaldrons of Coals cost £. 56 - 14: How much is it a Chaldron? Facit £. 1 - 11 - 6.

XIII. Sold 56 Pieces of Cloth for £. 241 - 17: At what Rate did I sell it *per Piece*? Facit £. 4 - 6 - $4\frac{1}{2}$.

XIV. Divide £. 1675 into 343 equal Shares. Facit £. 4 - 17 - 8 + $\frac{4}{343}$.

XV. If 378 Pieces of Cloth cost £. 2965 - 14 - 6: What does each Piece come to? Facit £. 7 - 16 - 11.

XVI. Bought 574 lbs. of Tobacco, for £. 18 - 10 - $8\frac{1}{2}$: How much is it *per lb.* Facit $7\frac{3}{4}$ d.

XVII. Sold 684 Hhds. of Wine, for £. 5801 - 3 - 6. What did I sell it *per Hhd.*? Facit £. 8 - 9 - $7\frac{1}{2}$.

XVIII. Bought 2783 lbs. 10 oz. 18 dwts. 6 gr. of Silver, in 174 Ingots, containing each the same Weight. What is the Weight of an Ingot? Facit 15 lbs. 11 oz. 19 dwts. 21 gr.



REDUCTION

Teacheth to convert one Denomination, or Species, into another, without altering the Value.

There are two Sorts of Reduction, viz. the *Descending*, which brings Numbers from a great Denomination into an inferior; and the *Ascending*, which brings Numbers from a low Denomination into a greater.

RULES. I. When Descending: Multiply the Quantity given by the Parts of the next lower Denomination a Whole may be divided into; and successively so, till you have brought that Quantity to the small Denomination required. Observing that, when in the Quantity given to be reduced there are several Denominations, you are to work as in CASE III. (EXAMPLE II.) of Division of Applicate Numbers.—If the last Denomination required is a Fraction, you are to multiply by the Denominator, taking in the Numerator.

II. When Ascending: On the contrary, divide the given Quantity by the Parts of the present Denomination, that are in a Whole of the next higher Denomination; and successively so, till you have brought that Quantity to the great Denomination required.

N. B. It often happens that a Question in Reduction may be compound, and must be resolved both by *Multiplication* and *Division*; or, both by *Division* and *Multiplication*: Therefore observe this **GENERAL RULE.** To bring great Names into small Names, multiply: and, to bring small Names into great Names, divide.

N. B. The Descending is proved by the Ascending; and the Ascending is proved by the Descending.

EXAMPLES.

I. In £. 243, How many Shillings, Pence, and Farthings? Facit 4860s. 58320d. and 233280 Farthings.

It is easy to perceive, that this Question must be worked by the Rule for Descending Reduction, since Shillings, Pence, and Farthings, are lower Denominations than Pounds. So:

To reduce £. into Shil. multiply £. 243
by - - 20 As 20s. make 1 Pound.

To reduce Shil. into d. multiply - 4860 Shillings..
by - - 12 As 12d. make 1s.

To reduce d. into Farth. multiply 58320 Pence.
by - - 4 As 4 Farth. make 1d.

233280 Farthings.

II. In 233280 Farthings, how many Pence, Shillings and Pounds? Facit 58320d. 4860s. and 243 Pounds.

It is easy to perceive that this Question must be worked by the Rule for Ascending Reduction, since Pence, Shillings, and Pounds, are greater Denominations than Farthings. So:

To

REDUCTION.

79

To have Pence, divide the Farthings by 4) 233280. As 4
Farthings = 1d.

To have Shillings, divide the Pence by 12) 58320d. As 12d.
= 1s.

To have Pounds, divide the Shillings by 20) 4860s. As 20s.
= £. 2.

III. In £. 341 - 8 - 7 $\frac{1}{4}$, how many Shillings, Pence and Farthings? Facit 6828s. + 7 $\frac{1}{2}$ d. 81943 $\frac{1}{2}$ d. and 327773 Farthings.

This being a Descending Reduction.

To have Shillings, $\times$ 341 l. 20 Taking in the 8s. of the given Sum.

To have Pence, $\times$ 6828s. 12 Taking in the 7d. of the given Sum.

To have Farthings, $\times$ 81943d. 4 Taking in the $\frac{1}{4}$ of the given Sum.

327773 Farthings.

IV. In 327773 Farthings, how many Pence, Shillings, and Pounds? Facit 81943 $\frac{1}{2}$ d. 6828s. 7 $\frac{1}{2}$ d. and £. 341 - 8 - 7 $\frac{1}{4}$.

This being an Ascending Reduction, I work as follows:

4) 327773 Farthings.

12) 81943d. + $\frac{1}{2}$.

20) 68218s. + 7 $\frac{1}{2}$ d.

£. 341 + 8s. 7 $\frac{1}{4}$ d.

V. In £. 51. 18s. 9d. How many Crowns, Shillings and Pence? Facit 207cr. + 3s. 9d. — 1038s. + 9d. and 12465d.

To have Crowns, multiply 51 Pounds.
by 4 taking in 3, for the 3 Cr. in 18s.

To have Shillings, multiply 207 Crowns.
by 5 taking in the 3s. over the 3cr.

To have Pence, multiply 1038 Shillings.
by 12 taking in the 9d.

12465d.

VI. In 12465d. How many Shillings, Crowns and Pence? Facit 1038s. + 9d. — 207cr. + 3s. 9d. and £. 51 + 3cr. + 3s. or 18s. + 9d.

To have s. divide d. by 12) 12465d.

To have cr. divide s. by 5) 1038s. + 9d.

To have £. divide cr. by 4) 207cr. + 3s. 9d.

£. 51 + 3cr. or 15s. + 3s. 9d.

VII

VII. In 454 Guineas, How many Pounds, Shillings, and Pence?

Facit 476 £. + 14s. — 9534s. and 114408d.

To have £. divide Gui. by 20) 454 Guineas.

which Quotient add - - - 22 + 14s.

To have Shillings multiply £. 476 £. 14s.
by - - - 20 taking in the 14 Shillings.

To have Pence, multiply Shil. 9534 Shillings.
by - - - 12

114408 Pence.

VIII. In 114408d. How many Shillings, Pounds, and Guineas?

Facit 9534s. — 476 £. + 14s. and 454 Guineas.

To have Shillings, divide Pence by 12) 114408

To have Pounds, divide Shillings by 20) 9534s.

To have Gui. subtract from Pounds $\frac{1}{20}$ } 476 £. + 14s.
thus: 476 - 14 ÷ 7 = 68 - 2 ÷ 3 = 22 - 14 } 22 + 14

Remain - - - 454 Guineas.

IX. In 464 Guineas, How many Shillings, Pence and Farthings?

Facit 9744s. — 116928d. and 467712 Farthings.

To have Shillings, multiply Guineas 464
by 21

464

928

To have Pence, multiply Shillings 9744s.
by 12

To have Farthings, multiply Pence 116928d.
by 4

467712 Farthings.

X. In 467712 Farthings, How many Pence, Shillings, and Guineas? Facit 116928 — 9744s. and 464 Guineas.

4) 467712

12) 116928 Pence.

As $3 \times 7 = 21$, So, $9744 \div 3 = 3248$ } 21) 9744 Shillings.
 $\div 7 = 464$ }

464 Guineas.

XI. In £. 16 - 6 - 2, How many Crowns, Half Crowns, Shillings, and Pence, of each an equal Number? Facit 38.

Such

REDUCTION.

81

Such a Question as this is resolved by bringing all the Denominations into the lowest required, for a Divisor; and reducing the given Sum likewise into the lowest mentioned Denomination, for a Dividend.

A Crown	= 60	£. 16	103)3914(38
A Half Crown	= 30	20 Taking in the 6s.	824
A Shilling	= 12		600
A Penny	= 1	326 Shillings.	
		12 Taking in the 2d.	

103d. Divisor. 3914d. Dividend.

XII. In 52 Crowns, as many Half Crowns, Shillings, and Pence, How many Farthings? Facit 21424.

Such a Question as this is resolved by bringing the Denominations into that of which the Answer is required to be, for Multiplier of the given Quantity.

A Crown	= 240 Farthings.	So, multiply	52
A Half Crown	= 120	by	412
A Shilling	= 48		624
A Penny	= 4		208
	412		21424

XIII. In 324 Moidores, How many Pounds Sterling? Facit £. 437 - 8.

Multiply the Moidores	324
By the 27 Shillings in a Moidore	27
	2268
	648

And the Product, divide by the Shillings } 210)87418
in a £. viz. } £. 437. 8s.

XIV. In 100 Portugal Pieces, at 36 Shillings each, How many Pounds, Half Crowns, and Crowns? Facit £. 180, 1440 Half Crowns, and 720 Crowns.

Multiply the Portugal Pieces	100
by the 36 Shillings in one	36

To have Pounds, divide by	210)36010s.
20 Shillings	180£.

To have Half Crowns X . . . 8

To have Crowns, divide	2)1440 Half Crowns.
Half Crowns, by	720 Crowns.

XV. A Merchant at London delivers to his Correspondent, as much Broad Cloth as comes to £. 547 - 14 - 7; and he is to receive

M

ceive

ceive the same in Cross Dollars, at 4s. 2d. each. How many must he receive? Facit 2629 Cross Dollars, and $\frac{5}{8}$ over.

Bring the Money into Pence, and divide by the Pence in 1 Dollar.

$$\text{A Dollar} = 4s. 2d. \\ \underline{12}$$

$$547 - 14 - 7 \\ \underline{20}$$

$$\text{or,} = 50d.$$

$$10954 \\ \underline{12}$$

Pence in a Dollar 5|0|13|45|5

2629 + $\frac{5}{8}$

XVI. In 276 Crusadoes, at 6s. 2d. each, How many Hungarian Ducats, at 4s. 8d. each? Facit 364 Ducats + 40 Pence over, or 3s. 4d.

$$\text{A Hung. Ducat} = 4s. 8d. \\ \underline{12}$$

$$276 \text{ Crus.} \\ \underline{74d. \text{ in a Crus.}}$$

$$\text{A Crus.} = 6s. 2d. \\ \underline{12}$$

$$\text{or, } 56d.$$

$$1104 \\ \underline{1932}$$

$$\text{or, } 74d.$$

Pence in a Ducat 56|204|24|364 Ducats.

362

264

40

N.B. In *Descending Reduction*, to bring at one Operation Pounds into Pence, multiply by 240, since 240 d. are equal to 1 Pound, as may be seen in the second Table of Money: and, to bring Pounds into Farthings, multiply by 960.

In *Ascending Reduction*, to bring Pence into Pounds, divide by 240: and, to bring Farthings into Pounds, divide by 960.

☞ After the same Manner, all Questions requiring to be reduced, whether in Money or Weights and Measures, being worked, there is no need for a further Explanation. I will now therefore, only shew,

THE USE OF REDUCTION.

When Quantities, consisting of several Denominations, are required or given to be either multiplied and divided, or divided and multiplied. 1st, By *Descending Reduction*, bring the said Quantities to the lowest mentioned Denomination. 2dly, According to the State of the Question, either multiply or divide, as in Whole Numbers, the Sums of the lowest Denominations. 3dly, By *Ascending Reduction*, bring the Product, or Quotient (which will then be of the lowest Denomination) to the primitive, or highest Denomination, such as the Question will require.

When

When the Divisor of any Quantity consists of Applicate Numbers, both the Divisor and Dividend must be brought to the lowest mentioned Denomination, before you divide.

Here may be observed, that whenever a Sum is to be either, first multiplied, then divided; or, first divided, then multiplied; both the Multiplication and the Division can often be contracted according to the Rules given in the Rule of Three by Contraction; that is, by taking in the Divisor such Part or Parts as may likewise be taken in either of the Multiplicand or Multiplier, till the Divisor, Multiplier or Multiplicand, is of a low Denomination, 1 if possible.

EXAMPLES.

I. What will 25cts. 3qrs. 14lbs. of Tobacco come to, at $15\frac{1}{2}d.$ per lb. ? Facit £. 187 - 3 - 3.

1st, 25cts.

and 15d.

2dly, 2898lbs.

62 Farthings.

$$\begin{array}{r} 4 + 3 \\ \hline 103 \\ 28 + 14 \\ \hline 838 \\ 206 \\ \hline 2898 \text{ lbs.} \end{array}$$

$$\begin{array}{r} 4 + 2 \\ \hline 62 \text{ Farthings.} \end{array}$$

$$\begin{array}{r} 5796 \\ 17388 \\ \hline \end{array}$$

3dly, 4) 179676 Farthings.

$$\begin{array}{r} 12) 44919d. \\ 2|0) 374|3s. 3d. \\ \hline \end{array}$$

$$\begin{array}{r} 12) 44919d. \\ 2|0) 374|3s. 3d. \\ \hline \end{array}$$

$$\begin{array}{r} 12) 44919d. \\ 2|0) 374|3s. 3d. \\ \hline \end{array}$$

1st, Pounds Weight being the lowest Denomination in the given Quantity, I have (by *Descending Reduction*) reduced the said Quantity to lbs; and thus found 2898lbs.

Then, as in the given Price, the lowest mentioned Denomination is Farthings, I have likewise (by *Descending Reduction*) reduced the said Price to Farthings; and thus found 62 Farthings.

2dly, 62 Farthings being the Price of 1lb. I have multiplied the 2898lbs. by 62 Farthings; and thus found that the 25cts. 3qrs. 14lbs. at $15\frac{1}{2}d.$ will come to 179676 Farthings.

3dly, I have (by *Ascending Reduction*) brought the 179676 Farthings into the highest Denomination, and found them to be equal to £. 187 - 3 - 3.

II. For £. 187 - 3 - 3, how many cts. qrs. and lbs. may I have of Tobacco, when the Price of 1lb. is $15\frac{1}{2}d.$? Facit 25cts. 3qrs. 14lbs.

1st, 15d.

and £. 187

2dly, 62) 179676 (2898

$$\begin{array}{r} 4 + 2 \\ \hline 62 \text{ Farth.} \end{array}$$

$$\begin{array}{r} 20 + 3 \\ \hline 3743 \\ 12 + 3 \\ \hline 44919 \\ 4 \\ \hline 179676 \end{array}$$

$$\begin{array}{r} 556 \\ 607 \\ 496 \\ 00 \\ \hline \end{array}$$

3dly, 28) 2898lbs. (103qrs.

$$\begin{array}{r} 098 4) 103 (25cts. \\ 14 23 \\ \hline 3qrs. over \end{array}$$

$$\begin{array}{r} 098 4) 103 (25cts. \\ 14 23 \\ \hline 3qrs. over \end{array}$$

$$\begin{array}{r} 098 4) 103 (25cts. \\ 14 23 \\ \hline 3qrs. over \end{array}$$

REDUCTION.

III. For £. 8 - 9 - 7 $\frac{1}{2}$, I have bought 1 Hhd. of Wine; How many Hhds. may I buy for £. 5801 - 3 - 6? Facit 584.

8	5801
20 + 9	20 + 3
169	116023
12 + 7	12 + 6
2035	1392282
4 + 2	4
8142 Farthings.	8142) 5569128 (684
	68392
	32568
	0000

CONTRACTIONS IN DESCENDING REDUCTION OF MONEY.

And where 20, 12, and 21, are Multiplier.

How many Pence are there in £. 98? Facit 23520d.

Double the given Pounds, annexing a Cypher thus: 1960

The Product of which, Double again, placing the Product one Place more to the right, thus: 3920

Then, the two Products added together give the Answer. 23520

In £. 4584, how many Shil. and Pence? Facit 91680s. 1100160d.

$$\begin{array}{r} 91680s. \\ 183360 \\ \hline 1100160d. \end{array}$$

In £. 342 - 17 - 3, how many Pence? Facit 82287d.

6857 } Here, as I was to join 17s. to the Product of 2s,
13717 } I have put 7 in the Room of 0 (Place of Units),
82287 } and to 4 (double of 2) I have joined 1 for the
Ten to be taken in. Then, in the Pence, doubling the last Figure 7, I have 14, which with 3d. to take in = 17; therefore I sat down 7, and carried 1.

How many Farthings, in £. 134 - 19 - 7 $\frac{3}{4}$? Facit 129583.

$$\begin{array}{r} 2699s. \\ 5495 \end{array}$$

32395d.

To have Farthings multiply by 4 taking in the 3,

$$\begin{array}{r} 129583 \end{array}$$

In

REDUCTION.

85

In 36 Guineas, how many Shil. and Pence? Facit 756s. 9072d.

$$\begin{array}{r} 72 \\ \hline 756s. \\ 1512 \\ \hline 9072 \end{array}$$
 To reduce Guineas into Shillings, instead of multiplying by 21, I set down the Double of the given Quantity, beginning to place the Figures under the Tens: Then I add the given Quantity and Double together. Afterwards, to have Pence, I double as before,

IN AVOIR DU POIDS WEIGHT,

And where 112 is Multiplier.

To reduce *Hundreds* into *lbs*, for more Ease, write down the given Quantity 4 Times under one another, in such a Manner, that the Units of the 3d Time be under the Tens of the others, and that the Units of the 4th Time be under the Tens of the 3d Time; thus:

How many *lbs*. are there in 36 *cts*? Facit 4032*lbs*.

$$\begin{array}{r} 36 \\ 36 \\ 36 \\ \hline 4032 \end{array}$$

In 7*cts*. 1*qr*. 14*lbs*. How many *lbs*? In 5*cts*. 2*qrs*. 8*lbs*, How many *lbs*.

$$\begin{array}{r} 7 \\ 7. \\ 7.. \\ 42 = 1qr. 14lbs. \\ \hline \end{array}$$

826, Answer.

$$\begin{array}{r} 5 \\ 5. \\ 5.. \\ 64 = 2qrs. 8lbs, \\ \hline \end{array}$$

624. Answer.

QUESTIONS TO EXERCISE THE LEARNER.

- I. In £. 345. How many Shillings? Facit 6900*s*.
- II. In 680 Shillings, How many Angels (each 10*s*. or $\frac{1}{4}$ of a £.) and Pounds? Facit 68 Angels, £. 34.
- III. In £. 343, How many Shillings and Pence? Facit 6860*s*. 82320*d*.
- IV. In £. 8160*d*. How many Shillings and Pounds? Facit 680*s*. £. 34.
- V. In £. 17 - 5 - $3\frac{1}{4}$. How many Farthings? Facit 16573.
- VI. In 47839 Farthings, How many Pounds? Facit £. 49 - 16 - $7\frac{3}{4}$.
- VII. How many Guineas in 21168 Farthings? Facit 21 *Guineas*.
- VIII. In 900 Pence, How many Shillings and Crowns? Facit 75*s*. 15 *Crowns*.
- IX. How many Crowns and Pounds in 500 Shillings? Facit 100 *Crowns*, £. 25.

X. In

X. In 439 Groats (each 4d. or $\frac{1}{3}$ of 1s.) How many Shillings and Guineas? Facit 146 s. 1 Groat; and 6 Guineas, 20s. 4d.

XI. In 46 Jacobus's (each 25 Shillings), How many Crowns, Half Crowns, Six Pences, and Pence? Facit 230 Crowns, 460 Half Crowns, 2300 Six Pences, 13800 Pence.

XII. Reduce 47 Thirty-six Shilling Pieces into Half-pence. Facit £. 40608.

XIII. Bring 97 Nobles (each 6s. 8d. or $\frac{1}{8}$ of a £.) into Pounds. Facit £. 32 - 6 - 8.

XIV. In 508 Marks (each 2 Nobles, or 13s. 4d. or $\frac{2}{3}$ of a £.) How many Nobles and Pounds? Facit 1016 Nobles, £. 338 - 13 - 4.

XV. How many Pieces of Eight (each 4s. 6d.) are equal to 48 Moldores? Facit 288.

XVI. In 15645 d. How many Crowns, Half Crowns, Shillings, and Pence, of each an equal Number? Facit 38.

XVII. In 1308 Half Crowns, as many Crowns and Shillings, How many Pounds? Facit £. 555 - 18.

XVIII. In 46 lbs. 6 oz. 13 dwts. 4 gr. of Silver, How many Grains? Facit 268156.

XIX. In 304207 Grains of Silver, How many lbs. Facit 52 lbs. 9 oz. 15 dwts. 7 gr.

XX. In 42 lbs. 1 oz. How many oz. dwts. and grains of Gold, of each an equal Number? Facit 480.

XXI. In 60 Tuns, How many lbs. Facit 134400.

XXII. In 1055358 Drams, How many Hundreds Weight? Facit 36 Cts. 3 qrs. 7 oz. 14 dr.

XXIII. How many Hundreds Weight, Quarters, Pounds, Ounces, and Drams, of each an equal Number, are there in 46 Tuns. 15 Cts. 1 qr. 18 lbs. 14 oz. 12 dr. Facit 44.

XXIV. Bought 27 Bags of Hops, each 2 Cts. 1 qr. 15 lbs. and 1 Bag of 137 lbs. How many Hundreds in the Whole? Facit 65 Cts. 2 qrs. 10 lbs.

XXV. In 75 Ells English, How many Yards? Facit 93 $\frac{3}{4}$ Yards.

XXVI. In 24 Pieces, each 32 Flemish Ells, How many Ells English? Facit 460 Ells, 4 qrs.

XXVII. Bought 12 Bales of Cloth, each 25 Pieces, each 15 Ells English, How many Yards? Facit 5625.

XXVIII. In 35 Hhds. of Wine, How many Gallons and Quarts? Facit 2205 Gallons, 8820 Quarts.

XXIX. In 1280 Quarts of Ale, How many Gallons and Barrels? Facit 320 Gallons, 10 Barrels.

XXX. In 46 Barrels of Beer, How many Gallons? Facit 1656.

XXXI. In 57 Miles, How many Poles? Facit 18240.

XXXII. In 8960 Perches of Land, How many Acres? Facit 56.

XXXIII. I am 25 Years old. How many Seconds are expired since my Birth Day, allowing 365 $\frac{1}{4}$ Days to a Year? Facit 788940000.

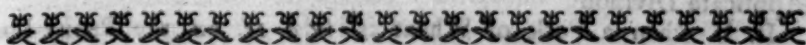
XXXIV. For

RULE OF THREE

87

XXXIV. For 470 Guineas, I received the following Pieces, viz. Pistoles at 16s. 6d. Half Guineas, Crowns, and Half Crowns; of each an equal Number: How many of each Sort did I receive? Facit 286 and $\frac{6}{9}$ over.

XXXV. £. 628 - 13 - 6. are to be paid in Moidores: What Number of Moidores must there be given? Facit 465 + 18s. 6d.



THE RULE OF THREE.

RULE. Work as in Whole Numbers; but, mind that if the Term, which you are to divide, or multiply by, is Applicate, you generally must (as has been observed in Reduction) reduce it, as likewise the other that signifies the same Thing, to the lowest mentioned Denomination, before you multiply and divide.

EXAMPLES.

I. If $27 \frac{1}{4}$ Yards of Muslin cost £. 9 - 5 - 0 $\frac{3}{4}$, what will $36 \frac{3}{4}$ Yards come to? Facit £. 12 - 9 - 6 $\frac{3}{4}$.

$$\begin{array}{rcl} \text{Yds.} & & \text{Yds.} \\ \text{As } 27 \frac{1}{4} & : & \text{£. } 9 - 5 - 0 \frac{3}{4} :: 36 \frac{3}{4} \\ \underline{4 + 1} & & \underline{4 + 3} \end{array}$$

$$\text{Or, } 109\text{grs.} : 9 - 5 - 0 \frac{3}{4} :: 147\text{grs.} : (7 \times 7 \times 3 = 147)$$

$$\begin{array}{r} 64 \\ - 15 - 5 \frac{1}{4} = 7 \end{array}$$

$$\begin{array}{r} 453 \\ - 8 - 0 \frac{3}{4} = 49 \end{array}$$

$$109) 1360 \quad 4 - 2 \frac{1}{4} \quad \left(\begin{array}{r} = 147 \\ 12 - 9 - 6 \frac{3}{4} + 109 \end{array} \right)$$

$$\begin{array}{r} 52 \\ 20 + 4 \end{array}$$

$$\begin{array}{r} 1044 \\ 63 \\ 12 + 2 \end{array}$$

$$\begin{array}{r} 758 \\ 104 \\ 4 + 1 \end{array}$$

$$\begin{array}{r} 417 \\ 90 \end{array}$$

Here,

Here, as the intended Divisor consisted of Quarters; I have reduced the Yards into Quarters: then, the Proposition requiring an Answer greater than the second Term, I have multiplied the second Term £. 9 - 5 - 0 $\frac{3}{4}$ by 147 (greater Extream), according to CASE II. in Applicate Multiplication; and divided by the first Term 109 (less Extream), according to CASE III. in Applicate Division.

II. If when a Peck of Wheat is sold 1s. 6d. the Penny-Loaf weighs 10oz. 10 $\frac{2}{3}$ dr: How much will it weigh when the Peck is worth 2s? Facit 8oz.

As 1s. 6d. : 10oz. 10 $\frac{2}{3}$ dr. :: 2s. :

Here as the first Term, intended to be the Multiplier, (the Proposition requiring an Answer less than the second Term) consists of a Six-Penny Denomination, I reduce, it as likewise the third, intended to be the Divisor, to that Name; and then the Stating runs thus:

As 3 Six-Pences : 10oz. 10 $\frac{2}{3}$ dr. :: 4 Six-Pences :

$$\begin{array}{r} 3 \\ \hline 4) 32 - 0 \\ 8oz. \end{array}$$

III. If 3 Yards cost 8s. 3d. What will 96 Ells English come to? Facit £. 16 - 10.

Here as the Terms that signify the same Thing are not in the same Denomination, I first bring them to the same Name, viz. Quarters, by multiplying the Yards by 4 and the Ells English by 5, and then the Stating runs thus:

$$\begin{array}{r} \text{As } 12qrs. : 8s. 3d. :: 480qrs. : \\ \text{Contracted, } 1 : 8 - 3 :: 40 : \\ \hline 5 \\ 2 \quad - \quad 1 \quad - \quad 3 \\ \hline 8 \\ \hline \text{£. } 16 - 10 - 0 \end{array} \left. \begin{array}{l} \\ \\ \end{array} \right\} 5 \times 8 = 40$$

IV. If 3 Yards cost 7s. What will 24 Yards cost? Facit £. 2 - 16.

$$\begin{array}{r} \text{As } 3 \text{ Yards} : 7s. :: 24 \text{ Yards} : \\ 7 \\ \hline 3) 168 \\ 2) 0) 516s. \\ \text{£. } 2 - 16 \end{array} \quad \begin{array}{l} \text{By Contraction.} \\ \text{As } 1 \text{ Yard} : 7s. :: 8 \text{ Yards.} \\ 8 \\ \hline 56s. \text{ or } \text{£. } 2 - 16. \end{array}$$

If a Gentleman's Income is £. 500 a Year, and he spends 19s. 4d. per Day, How much does he lay by at the Year's End, allowing 365 Days in it? Facit £. 147 - 3 - 4.

IN APPLICATE NUMBERS. 89

In this Question, 1st, I find out the Total of his Expences at the Year's End, thus:

As 1 Day : 19s. 4d. :: 365 Days.

$$\begin{array}{r} 12 + 4 \\ \hline 232 \text{ d.} \end{array} \quad \begin{array}{r} 232 \text{ d.} \\ 730 \\ 1095 \\ 730 \cdot \cdot \\ \hline \end{array}$$

12)84680 d.

2)0 705)6s. 8d.

£. 352 - 16 - 8. Total of his Expences.

Then, to know what he lays by, I subtract from the yearly In-

come - - - - - £. 500 - 0 - 0

The Expences - - - - - £. 352 - 16 - 8

The Remainder will give the Answer - - - £. 147 - 3 - 4

A Gentleman has an Estate, which brings him in clear £. 2000 a Year; and the Charges he is at, one Day with another, for House-keeping and other Expences, is £. 5 - 15s. I demand what he loses or saves?

As 1 Day : £. 5 - 15 :: 365 Days.

$$\begin{array}{r} 20 + 15 \\ \hline 115 \end{array} \quad \begin{array}{r} 115 \text{ s.} \\ 1825 \\ 4015 \\ \hline \end{array}$$

2)0 4197)5s.

£. 2098 - 15. Total of his Expences.

Here, since the Expences exceed the Income, he certainly must lose; and to know how much, from the Expences £. 2098 - 15 - 0

Subtract the Income - - - - - 2000 - 0 - 0

The Remainder will quote the Loss - - - 98 - 15 - 0

QUESTIONS TO EXERCISE THE LEARNER.

I. If 14 Men can finish a Job in 18 Days: How many Days, Hours, &c. will 34 take to do the same? Facit 7 D. 4 H. 56' + 16.

II. For £. 10 - 11 - 3 I had 29lbs. 4 oz. of Coffee: What would 3 lbs. cost? Facit £. 1 - 1 - 8.

III. I lent a Friend £. 200, which 6 Months after he returned to me: Another Time I wanted £. 500, which he lent me: How long may I keep his £. 500, to indemnify myself? Facit 2 Months, 12 Days; allowing 30 Days to a Month.

IV. If 48lbs. of Raisins cost 13s. What will 18 Fraills cost, each weighing 3 qrs. 18 lbs.? Facit £. 24 - 17 - 3.

N

V. Eor-

V. Borrowed of my Friend £. 64 for 8 Months, and he has Occasion another Time to borrow of me for 12 Months: How much must I lend him to requite his former Kindness to me? Facit £. 42 - 13 - 4.

VI. If 8s. gain 13s. 4d. What will 15s. gain? Facit £. 1 - 5.

VII. If 60 Gallons of Water, in one Hour's Time, fall into a Cistern, containing 200 Gallons; and by a Pipe in the same Cistern there runs out 45 Gallons in an Hour: In how many Hours will it be filled? Facit 13 H. 20 Min.

From 60 filling Cock, subtract 45 emptying Cock, Remain 15
So, 15 Gall : 1 H. :: 200 Gall : 13 H. 20 Min.

VIII. A Merchant owes £. 1000, but all he has, is only worth £. 625: How much are his Creditors to receive in the Pound? Facit 12s. 6d.

IX. If with £. 420 - 12 - 6. I gained £. 100: How much will I gain with £. 1500? Facit £. 356 - 12 - 2 $\frac{3}{4}$ + $\frac{6}{7}$.

X. If 6 Yards cost 16s. 6d: How many Ells English may I have for £. 33? Facit 192 Ells.

As 198d. : 6 yds. :: 7920 d. : 240 yds.

Now to have Ells 240 $\times$ 4 qrs. = 960 qrs. $\div$ 5 = 192 Ells.

XI. If 96 Ells English cost £. 16 - 10: What cost 3 Yards? Facit 8s. 3d.

XII. What may one save at the Year's End, who has £. 456 - 15 per Annum, and spends only £. 4 - 13 - 4 per Week? Facit £. 214 1 - 8.

As 1 Week : £. 4 - 13 - 4 :: 52 Weeks : £. 242 - 13s. - 4d. yearly Expences: So, 456 - 15 - 242 - 13 - 4 = 214 - 1 - 8.

XIII. A Taylor makes a Great Coat with 6 Yards of Stuff, $\frac{1}{2}$ a Yard wide: How many Yards of a Stuff, 3 qrs. wide, will line it? Facit 4 Yards.

XIV. If for 5 $\frac{3}{4}$ Yards of Cloth, I get £. 4 - 12. What may I reckon 84 $\frac{1}{2}$ Yards worth? Facit £. 67 - 12.

XV. How much Paper, 3 qrs. of a Yard broad, will line a Room 70 Yards in Circumference, and 6 Yards high? Facit 560 Yards.

XVI. Bought 27 Dozens 5 lbs. of Candles, after the Rate of 17 d. per 3 lbs. What did they cost me? Facit £. 7 - 15 - 4 $\frac{1}{4}$ + 1.

XVII. Sold 33 Chaldrons 12 Bushels of Coals, for £. 50: How much is it per Bushel? Facit 10d.

XVIII. A Wine Merchant bought an equal Quantity of Bottles, of six different Sorts of Burgundy Wine, which cost him £. 400. A Bottle of the 1st Quality cost 5s. 3d. of the second 4s. 6d. of the third 4s. 3d. of the fourth 4s. of the fifth 3s. 9d. and of the sixth 3s. 3d. How many Bottles of each had he? Facit 320.

The Prices added together = 25s. So, 25s : 1 :: 8000s : 320.

XIX. If my Horse stands me in 9 $\frac{1}{2}$ d. per Day Keeping: What will be the Charge of 11 Horses for the Year? Facit £. 158 - 18 - 6 $\frac{1}{2}$.

IN APPLICATE NUMBERS. 91

As 1 Day : $9\frac{1}{2}d.$ or 38 Farthings :: 365 Days : 13870 Farthings yearly Expence of one Horse, $\times 11 = 152570$ Farthings yearly Expence of 11 Horses, or $\pounds. 158 - 18 - 6\frac{1}{2}$.

XX. The Rents of a whole Parish amount to $\pounds. 1750$, and a Rate is granted of $\pounds. 32 - 16 - 3$: What is that in the Pound? Facit $4\frac{1}{2}d.$

As $\pounds. 1750 : \pounds. 32. 16s. 3d. :: \pounds. 1 : —$ Reduced $\pounds. 1750 : 7875d. :: \pounds. 1 : 4\frac{1}{2}d.$

XXI. What must I give for the $\frac{6}{32}$ Parts of a Ship, that is worth $\pounds. 635 - 15$? Facit $\pounds. 119 - 2 - 2\frac{1}{4}$.

As 32 Parts : $\pounds. 635. 5s. :: 6$ Parts : $119 - 2 - 2\frac{1}{4}$.

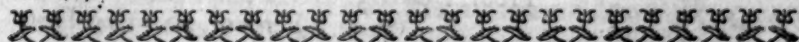
XXII. Sold 4 lbs. 11 oz. 10 dwts. of Plate, at 5s. 4d. per Ounce: What does it come to? Facit $\pounds. 15 - 17 - 4$.

As 1 oz. or 210 dwts. : 5s. 4d. or 64d. :: 4 lbs. 11 oz. 10 dwts. or 1190 dwts. : —

Contracted 1 dwt. : 32 d. :: 119 dwts. : 3808d. or $\pounds. 15 - 17 - 4$.

XXIII. There is a Steeple, which stands right upon Level Ground, whose Shadow measures 75 Yards, at the same Time that the Shadow of a straight Walking Stick, which is a Yard long, measures 5 Feet: I demand the Height of the Steeple. Facit 45 Yards.

As 5 Feet : 1 yd. :: 75 yds. or 225 Feet : 45 yds.



PRACTICE.

To do an Operation by *Practice*, is to work it in as concise and expeditious a Manner, as may be thought of: namely, by the Help of common Multiples, if the given Quantity is small, and can be so divided; but, most commonly by taking aliquot or even Parts, by which Means many heavy and tedious Multiplications and Divisions are avoided.

The following Methods will, I think, prove to be much easier and shorter than any that has as yet been laid before the Public.

CASE I. Shillings being in the Multiplier, to find their Product in Pounds and Shillings at once.

RULE. If the Number of Shillings be even, multiply by half of them, observing to carry the Tens, and to double what is above Tens in the Amount of the last Figure, Right-Hand, which Double write at the Column of Shillings.

If the Number of Shillings be odd, multiply as above by half the Number of Shillings, less 1; then for the other Shilling, take half of the Multiplicand, except the last Figure Right Hand, which must be written at the Column of Shillings.

N 2

EXPLA-

EXPLANATION OF THE RULE.

1st, Since there are 20 Shillings in 1 Pound, 1 Shilling is $\frac{1}{20}$ of any Quantity given to be multiplied. Hence it results, that cutting the last Figure, the Half of the others Left-Hand will give Pounds, and the last Figure, in its full Value, will be Shillings; which is the same as to divide by 20, according to CASE III. in Division of Whole Numbers.

EXAMPLE.

At 1s. a Thing; What will 655 cost? Facit £. 32 - 15s.

$$\begin{array}{r} 65|5 \\ \text{£. } 32 - 15 \end{array} \quad \begin{array}{l} \text{Proof } 2|0)65|5s. \\ 32 + 15 \text{ Parts of } 20 \\ \text{or } 15s. \end{array}$$

The Half of 65 = 32 £. and 1 over worth Ten of the last Column, and 5 in the said last Column = 15s. to set down.

2dly, Since 1s. = $\frac{1}{20}$ of a Pound, 2s. = $\frac{1}{10}$. Hence it results, that cutting as above the last Figure, the others Left-Hand will be Pounds, and the Double of the last Figure will be Shillings.

EXAMPLE.

At 2s. a Thing; What will 655 cost? Facit £. 65 - 10s.

$$\begin{array}{r} 65|5 \\ \text{£. } 65 - 10 \end{array} \quad \begin{array}{l} \text{Proof } 1|0)65|5 \\ 65 + 5 \text{ Parts of } 10 = 10 \text{ Parts} \\ \text{of } 20 \text{ or } 10s. \end{array}$$

3dly, Now it is evident that when Shillings consist of an even Number, we may get at once the Product in Pounds, by multiplying by the Half of them; observing to double what is above or under Ten or Tens in the Amount of the last Figure, which Double will give the Shillings; for it is to be considered, that we work by as many Two Shillings, as there are Units in that Half.

EXAMPLE.

At 16s. a Thing; what will 578 cost? Facit £. 462 - 8s.

$$\begin{array}{r} 57.8 \\ \hline 0 - 16 \\ \hline \text{£. } 462 - 8 \end{array} \quad \left. \begin{array}{l} 8 \\ 8 \times 8 = 64: \text{ So, double } 4 \text{ that are over } 60, \text{ and you'll} \\ \text{have } 8s; \text{ for the } 6 \text{ Tens in } 60, \text{ carry } 6 \text{ in Mind.} \\ \text{Then proceed, } 8 \times 7 = 56 + 6 \text{ that you carry} = 62, \\ \text{write down } 2 \text{ and carry } 6. \text{ Lastly, } 8 \times 5 = 40 + 6 \\ \text{that you carry} = 46 \text{ to set down.} \end{array} \right\}$$

Bought 173 Yards of Cloth, at 12s. per Yard; How much did it cost in all? Facit £. 103 - 16s.

$$\begin{array}{r} 17|3 \\ \hline 6 \\ \hline 0 - 12 \\ \hline \text{£. } 103 - 16 \end{array} \quad \begin{array}{r} \text{£. } 103 \\ 20 + 16 \\ \hline 12)2076 \\ 173 \text{ Proof,} \end{array}$$

Sold

PRACTICE.

93

Sold 345 Yards of Holland, at 7s. per Yard. Facit £. 120 - 15.

$$\begin{array}{r} 345 \\ 3 + 1 \\ \hline 0 - 7 \\ \hline \end{array} \quad \begin{array}{r} 345 \\ 7s. \\ \hline 240 \overline{) 2415} \\ \underline{240} \\ 15 \\ \hline \end{array}$$

£. 120 - 15 Proof.

$$\begin{array}{r} 6s = 103 - 10 \\ 1 = 17 - 5 \\ \hline \end{array}$$

£. 120 - 15

Bought 35 Yards of Cambrick, at 18s. per Yard. Facit £. 31 - 10.

$$\begin{array}{r} 35 \\ 18s. \\ \hline 0 - 9 \\ \hline \end{array} \quad \begin{array}{r} 5 \\ \hline 4 - 10 = 5 \\ \hline 7 \end{array}$$

£. 31 - 10

£. 31 - 10 = 35 Proof.

Questions. I. At 1s. a Thing: What will 645 cost? Facit £. 32 - 5s.

II. At 2s. a Yard: What will 348 cost? Facit £. 34 - 16s.

III. What cost 47 Yards of Holland, at 3s. each? Facit £. 7 - 1s.

IV. Sold 48 Pairs of Shoes, at 4s. each. Facit £. 9 - 12s.

V. If 1 Week cost 6s. What will 52 come to? Facit £. 15 - 12s.

VI. Bought 346 Ells of Cloth, at 7s. per Ell? Facit £. 121 - 2s.

VII. Sold 83 Hats, at 8s. a Hat. Facit £. 33 - 4s.

VIII. What will 47 Days come to, at 9s. per Day? Facit £. 21 - 3s.

IX. If I lose 11s. a Day; What is it a Year (365 Days)? Facit £. 200 - 15s.

X. What will 546 Cwts. come to, at 12s. per Cwt.? Facit £. 327 12s.

XI. If one Man costs 13s. What will 113 come to? Facit £. 73 - 9s.

XII. If 1 gives 14s. What will 98 give? Facit £. 68 - 12s.

XIII. At 15s. for one: What will 337 come to? Facit £. 252 - 15s.

XIV. Paid 16s. for one: What must I pay for 1764? Facit £. 1411 - 4s.

XV. What will 370 come to, at 17s. one? Facit £. 314 - 10s.

XVI. Bought 546 Yards of superfine Cloth, at 18s. per Yard, Facit £. 491 - 8s.

XVII. Sold the same 546 Yards, at 19s. per Yard. Facit £. 518 - 14s.

Note I. When the Price is Pounds and Shillings, multiply the Quantity by the Pounds, then work for the Shillings as before directed; and the Sums added together will give the Answer:

What cost 234 Pieces of Holland, at £. 2. 9s. per Piece. Facit £. 573 - 6s.

23/4

$\begin{array}{r} 23 \overline{) 4} \\ 4 + 1 \\ \hline 2 - 9 \end{array}$	Proof by Division. $\begin{array}{r} 234 \overline{) 573} \\ 105 \\ \hline 20 + 6 \end{array}$
$\begin{array}{r} 2 \text{ £.} = 468 \\ 8 \text{ s.} = 93 - 12 \\ 15 \text{ s.} = 11 - 14 \end{array}$	$\begin{array}{r} 2106 \\ \dots \end{array}$

$$2 - 9 = 573 - 6$$

Questions. I. What cost 1746 Men a Month, at £. 1 - 14s. each? Facit £. 2968 - 4s.

II. What does the Rent of 44 Years come to, at £. 54 - 19s. per Annum? Facit £. 2417 - 16s.

III. What cost 678 Chaldrons of Scotch Coals, at £. 2 - 3s. per Chaldron? Facit £. 1457 - 14s.

IV. What cost 41 Loads of Hay, at £. 2 - 13s. per Load? Facit £. 108 - 13s.

V. Bought 43 Hhds. of Wine, at £. 5 - 19s. each? Facit £. 255 - 17s.

VI. Sold 459 Pieces of Cloth, at £. 3 - 17s. per Piece. Facit £. 1767 - 3s.

VII. A Treasurer is to pay 346 Officers £. 25 - 16s. each; What Sum must the Treasurer have to pay them? Facit £. 8926 - 16s.

Note II. When the Quantity is Fractional, after having worked with the Pounds and Shillings, as before directed, without minding the Fraction, take Part or Parts of the Price, which adding to the other Products, the Total will quote the Answer.

Bought $346 \frac{3}{4}$ Yards of Cloth, at £. 1 - 6s. per Yard.

$\begin{array}{r} 346 \overline{) 3} \\ 1. \quad 6 \\ \hline 346 = \left\{ \begin{array}{l} 346 \\ 103 - 16 \\ 0 - 13 \\ 0 - 6-6 \end{array} \right. \end{array}$	Proof. $\begin{array}{r} 1 \\ 20 + 6 \\ \hline 26 \\ 12 \\ \hline 312 \end{array}$	$\begin{array}{r} 450 \\ 20 + 15 \\ \hline 9015 \\ 12 + 6 \\ \hline 108186 \end{array}$
$\begin{array}{r} \frac{1}{2} = \cdot 0 - 13 \\ \frac{1}{4} = \cdot 0 - 6-6 \end{array}$	$\begin{array}{r} 108186 (346 + \frac{234}{312} \text{ or } \frac{3}{4}) \\ 1458 \\ 2106 \\ \hline 234 \end{array}$	$\begin{array}{r} 346 \frac{3}{4} = \cdot 450 - 15-6 \end{array}$

CASE II. The Price consisting of Pence, to find their Products in Pounds, Shillings, and Pence at once.

1st, Having the Product of 1s.

RULE. Since 1s = 12 Pence, if you have the Product of 1s. then, for the given Pence, you may upon the said Product, take their Aliquot Parts, according to the following

TABLE

PRACTICE.

95

TABLE OF ALIQUOT PARTS OF 12d.

- 1d. = the 12th Part of the Product of 1s.
 2 = - - 6th.
 3 = - 4th.
 4 = - 3d.
 5 = - 3d, and the 4th of the Product of that 3d.
 6 = - half.
 7 = - half, and the 6th of the Product of that Half.
 8 = - twice the 3d.
 9 = - half, and again the half of the Product of that Half.
 for 10 work as for 6d. and then as for 4d.
 for 11 work as for 8d. and then as for 3d.

EXAMPLES.

At 7s. 4d. a Thing; What will 976 cost? Facit £. 357 - 17 - 4.
 976 Proof by Division.

$$\begin{array}{r} 3 + 1 \\ \hline 0 - 7 - 4 \end{array} \quad \begin{array}{r} \text{£. s. d.} \\ 976) 357 - 17 - 4(0 - 7 - 4 \\ 20 + 17 \end{array}$$

$$\begin{array}{r} 292 - 16 - = 6s. \quad 7157 \\ 4d = \frac{1}{3} \text{ of } 1s. \text{ So, } 3) 48 - 16 - = 1s. \quad 325 \\ 16 - 5 - 4 = - 4d. \quad 12 + 4 \\ \hline 357 - 17 - 4 = 7 - 4 \quad 3904 \end{array}$$

In the above Example I find that one Shilling produces £. 48 - 16s. Then, as I have 4d. to get the Product of, I consider how many Times 4 are contained in 12, and finding that it is 3 Times, I take the 3d, in the said Product of 1s. (£. 48 - 16s.) which gives £. 16 - 5 - 4. for the Product of 4d.

At £. 3 - 9s. - 7d. a Thing; What will 453 come to? Facit £. 1576 - 1 - 3.

$$\begin{array}{r} 45|3 \\ 4 + 1 \\ \hline 3 - 9 - 7 \end{array}$$

$$\begin{array}{r} 1359 - - - = 3 \text{ £.} \\ 181 - 4 - = 0 - 8s. \\ 6d. = \frac{1}{2} \text{ of } 1s. \text{ So, } 2) 22 - 13 - - = 0 - 1 \\ 1 = \frac{1}{6} \text{ of } 6d. \text{ So, } 6) 11 - 6 - 6 = 0 - 0 - 6d. \\ 1 - 17 - 9 = 0 - 0 - 1 \\ \hline 1576 - 1 - 3 = 3 - 9 - 7 \end{array}$$

Bought

Bought 753 Hhds. of Wine, at £. 8 - 13 - 3 per Hhd. What does the Whole come to? Facit £. 6522 - 17 - 3.

7513

6 + 1

8 - 13 - - 3

6024 - - - = 8£.

451 - 16 - - = 0 - 12s.

37 - 13 - - = 0 - 1

9 - 8 - 3 = 0 - 0 - 3d.

6522 - 17 - 3 = 8 - 13 - 3

3d. = $\frac{1}{4}$ of 1s. So, 4)

adly, Having not the Product of 1s.

RULE. When you have no Shilling, or when the given Shillings consist of an even Number, then it is better to follow this

TABLE OF ALIQUOT PARTS OF 24d.

Of the Figures that precede the last, Right Hand, considered as Pounds. Of the last Figure, Right Hand, considered as Shillings.

For 1d. - take the 24th Part - and - - 12th.

2 - - - - 12th - - - - 6th.

3 - - - - 8th - - - - 4th.

4 - - - - 6th - - - - 3d.

5d. work for 4d. Then for 1d. over, take the fourth of the 4d.

6 - - - - 4th - - - - Half.

7 as for 6d. then for 1d. over, take the 6th of the 6d.

8 - - - - 3d. - - - - twice the 3d.

9 as for 6d. then for 3d. over, take the Half of the 6d.

10 as for 6d. then for 4d.

11 as for 8d. then as for 3d.

N. B. From this Table it is evident, that in the Figures considered as Pounds (that is: in those Figures that precede the last), you are only to take the Half of what you should take, according to the other Table of Aliquot Parts of 1s.—This Method is calculated in order to avoid dividing by 20s. to have Pounds; and it takes its Ground from what has been observed about 1 and 2 Shillings, (CASE I.)

EXAMPLES.

Bought 679 Pieces of Holland, at £. 3 - 18 - 4. What is it in all? Facit £. 2659 - 8 - 4.

67|9

9

3 - 18 - 4

2037 - - = 3 £.

611 - 2 - = 0 - 18s.

4d. = 6th and 3^d 11 - 6 - 4 = 0 - 0 - 4d.

2659 - 8 - 4 = 3 - 18 - 4

In the above Example, there being 4d. in the Price (after having worked with the Pounds and Shillings), I consider how many Times 4d. are contained in 24, and finding that it is 6 Times, I take the 6th of 67, which I find to be 11 and 1 over; therefore I write 11 at the Pounds; and as there is one over, the last Figure will be worth 10s. the third of which being 6 and 1 over, I write 6 at the Shillings; and as there is 1s. over, it is equal to 12d. the third of which being 4, I write 4 at the Pence.

If I save 7d. a Day, How much is it *per annum*? Facit £. 10 12 - 11.

36|5

0 - 0 - 7d.

6d. = 4th and $\frac{1}{2}$ - - 9 - 2 - 61d. = $\frac{1}{6}$ of 6d. - - 1 - 10 - 5

10 - 12 - 11

QUESTIONS.

I. If I spend 4s. 3d. How much is it *per annum* (365 Days)? Facit £. 77 - 11 - 3.

II. Bought 456 lbs. of Candles, at 6d. *per lb.* Facit £. 11 - 8.

III. Sold 354 lbs. of Cheefe, at 8d. *per lb.* Facit £. 11 - 16.

IV. If Coals sell at £. 2 - 6 - 5. *per Chaldron*, What will 248 Chaldrons come to? Facit £. 575 - 11 - 4.

V. Bought 354 Pieces of Velvet, at £. 4 - 16 - 11. *per Piece.* Facit £. 1715 - 8 - 6.

VI. Sold 456 Dozens of Candles, at the Rate of 6s. 3d. *per Dozen.* Facit £. 142 - 10.

VII. B. owes me £. 500, but can pay only 12s. 6d. in the Pound; What am I to receive in all? Facit £. 312 - 10.

VIII. 346, at 1d. Facit £. 1 - 8 - 10.

IX. 476, at 2d. Facit £. 3 - 19 - 4.

X. 945, at 3d. Facit £. 11 - 16 - 3.

XI. 734 at 4d. Facit £. 12 - 4 - 8.

XII.

- XII. 859, at 5*d.* Facit £. 17 - 17 - 11.
 XIII. 576, at 6*d.* Facit £. 14 - 8 - 0.
 XIV. 496, at 7*d.* Facit £. 14 - 9 - 4.
 XV. 876, at 8*d.* Facit £. 29 - 4 - 0.
 XVI. 1146, at 9*d.* Facit £. 42 - 19 - 6.
 XVII. 849, at 10*d.* Facit £. 35 - 7 - 6.
 XVIII. 778, at 11*d.* Facit £. 35 - 13 - 2.

CASE III. When there are Farthings in the Price.

RULE. If the given Price consists of Farthings only, then take the Aliquot Parts they form in a Penny (you'll have Pence); and afterwards, divide by 12 to have Shillings, and by 20 to have Pounds.

If the given Price consists of Pence and Farthings, work with the Pence in such a Manner as to enable you to take the Aliquot Parts those Farthings may form in a Penny, two Pence, three Pence, &c. according to the following

T A B L E S.

For 1 Farthing, or $\frac{1}{4}$, take	$\left\{ \begin{array}{l} \text{The Fourth of } 1d. \\ \text{The Eighth of } 2 \\ \text{The 12th of } 3 \end{array} \right.$	For 2 Farthings, or $\frac{1}{2}$, take	$\left\{ \begin{array}{l} \text{The Half of } 1d. \\ \text{The Fourth of } 2 \\ \text{The Sixth of } 3 \\ \text{The Eighth of } 4 \\ \text{The 12th of } 6 \end{array} \right.$
For 3 Farthings, or $\frac{3}{4}$, take	$\left\{ \begin{array}{l} \text{The Fourth of } 3d. \\ \text{The Eighth of } 6 \\ \text{In all other Cases, work as for a Half Penny, then} \\ \text{for the other Farthing (or } \frac{1}{4} \text{) take the Half of the} \\ \text{Product of a Half-Penny.} \end{array} \right.$		

N. B. $1 \frac{1}{2}d.$ (or three Half-Pence) $= \frac{1}{3}$ of 1*s.*

EXAMPLES.

At $\frac{1}{4}$ a Thing, what will 578 come to? Facit £. 0 - 12*s.* - 0 $\frac{1}{2}d.$
 $\frac{1}{4} = \frac{1}{4}) 578$

$$\begin{array}{r} 12) 144d. \quad \frac{1}{2} \\ 12*s.* \quad 0 \quad \frac{1}{2} \end{array}$$

At $\frac{1}{2}$ a Pound of Potatoes, what will 957 *lbs.* cost? Facit
 £. 1 - 19 - 10 $\frac{1}{2}$.

$$\begin{array}{r} \frac{1}{2} = \frac{1}{2}) 957 \\ 12) 478d. \quad \frac{1}{2} \\ 210) 39*s.* \quad 10 \frac{1}{2}d. \\ \text{£. 1} \quad 19*s.* \quad 10 \frac{1}{2} \end{array}$$

Bought

PRACTICE,

99

Bought 769 lbs. of old Iron at $\frac{3}{4}$ per lb. Facit £. 2 - 8 - 0 $\frac{3}{4}$.

$$\begin{array}{r} \frac{1}{4} = \frac{1}{2} \text{) } 384 \frac{1}{2} d. \\ \frac{1}{4} = \frac{1}{2} \text{) } 192 \frac{1}{4} \end{array}$$

$$\begin{array}{r} 12 \text{) } 576 \frac{3}{4} d. \\ 2 \text{ | } 0 \text{) } 4 \text{ | } 8 s. \quad 0 \frac{3}{4} \\ \hline \pounds. 2 \quad 8 \quad - \quad 0 \frac{3}{4} \end{array}$$

At $2 \frac{1}{4} d.$ one, What will 546 come to? Facit £. 5 - 2 - 4 $\frac{1}{2}$.

$$\begin{array}{r} 54 \text{ | } 6 \\ \hline 0 - 0 - 2 \frac{1}{4} \end{array}$$

$$\begin{array}{r} 2d. = \text{the 12th and 6th} \quad 4 - 11 - 0 \\ \frac{1}{4} = \frac{1}{8} \text{ of } 2d. \quad \quad \quad 0 - 11 - 4 \frac{1}{2} \end{array}$$

At $5 \frac{3}{4} d.$ a lb. What will 747 cost? Facit £. 17 - 17 - 11 $\frac{1}{4}$.

$$\begin{array}{r} 74 \text{ | } 7 \\ \hline 0 - 0 - 5 \frac{3}{4} \end{array} \quad \text{Or thus,} \quad \begin{array}{r} 74 \text{ | } 7 \\ \hline 0 - 0 - 5 \frac{3}{4} \end{array}$$

$$\begin{array}{l} 4d. = \frac{1}{6} \text{ and } \frac{1}{3} \quad 12 - 9 - 0 \quad 2d. = \frac{1}{12} \text{ and } \frac{1}{6} \quad 6 - 4 - 6 \\ 1 = \frac{1}{4} \text{ of } 4d. \quad 3 - 2 - 3 \quad 3 = \frac{1}{8} \text{ and } \frac{1}{4} \quad 9 - 6 - 9 \\ \frac{1}{2} = \frac{1}{2} \text{ of } 1d. \quad 1 - 11 - 1 \frac{1}{2} \quad \frac{3}{4} = \frac{1}{4} \text{ of } 3d. \quad 2 - 6 - 8 \frac{1}{4} \\ \frac{1}{4} = \frac{1}{2} \text{ of } \frac{1}{2} \quad 0 - 15 - 6 \frac{3}{4} \end{array}$$

$$17 - 17 - 11 \frac{1}{4}$$

Bought 654 Hundreds of Wine at £. 3 - 14 - 4 $\frac{1}{4} d.$ What does the whole come to? Facit 2431 - 7 - 7 $\frac{1}{2}$.

$$\begin{array}{r} 65 \text{ | } 4 \quad 7 \\ \hline 3 - 14 - 4 \frac{1}{4} \end{array}$$

$$\begin{array}{r} 3d. = \frac{1}{3} \text{ and } \frac{1}{4} \quad 457 - 16 \\ 1 = \frac{1}{3} \text{ of } 3d. \quad 8 - 3 - 6 \\ \frac{1}{4} = \frac{1}{4} \text{ of } 1d. \quad 2 - 14 - 6 \\ \quad \quad \quad 0 - 13 - 7 \frac{1}{2} \end{array}$$

$$2431 - 7 - 7 \frac{1}{2}$$

At $7 \frac{3}{4} d.$ a Thing, What will 798 cost? Facit £. 25 - 15 - 4 $\frac{1}{2}$.

$$\begin{array}{r} 79 \text{ | } 8 \\ \hline 0 - 0 - 7 \frac{3}{4} \end{array} \quad \text{Or thus,} \quad \begin{array}{r} 79 \text{ | } 8 \\ \hline 0 - 0 - 7 \frac{3}{4} \end{array}$$

$$\begin{array}{l} 6d. = \frac{1}{4} \text{ and } \frac{1}{2} \quad 19 - 19 - 0 \quad 4d. = \frac{1}{6} \text{ and } \frac{1}{3} \quad 13 - 6 - \\ 1 = \frac{1}{6} \text{ of } 6d. \quad 3 - 6 - 6 \quad 3 = \frac{1}{8} \text{ and } \frac{1}{4} \quad 9 - 19 - 6 \\ \frac{3}{4} = \frac{1}{8} \text{ of } 6d. \quad 2 - 9 - 10 \frac{1}{2} \quad \frac{1}{4} = \frac{1}{4} \text{ of } 3d. \quad 2 - 9 - 10 \frac{1}{2} \end{array}$$

$$25 - 15 - 4 \frac{1}{2}$$

$$25 - 15 - 4 \frac{1}{2}$$

QUESTION

QUESTIONS TO EXERCISE THE LEARNER.

- I. What cost 1753 lbs. of (any Thing) at $3\frac{1}{2}d.$ per lb. Facit £. 25 - 11 - $3\frac{1}{2}$.
- II. Bought 348 Chaldrons of Scotch Coals at £. 2 - 4 - $9\frac{3}{4}$ per Chaldron. Facit £. 779 - 14 - 9.
- III. At $4\frac{1}{2}d.$ one, What cost 234? Facit £. 4 - 7 - 9.
- IV. If one cost $10\frac{3}{4}d.$ What will 238 come to? Facit £. 10 - 13 - $2\frac{1}{2}$.
- V. At $2\frac{1}{2}d.$ What cost 243? Facit £. 2 - 10 - $7\frac{1}{2}$.
- VI. At $4\frac{1}{4}d.$ What cost 525? Facit £. 9 - 5 - $11\frac{1}{4}$.
- VII. At $11\frac{1}{4}$. What cost 342? Facit £. 16 - 0 - $7\frac{1}{2}$.
- VIII. At $\frac{1}{4}$ per lb. What cost 1779? Facit £. 1 - 17 - $0\frac{3}{4}$.
- IX. At $\frac{1}{2}$ per lb. What cost 1849? Facit £. 3 - 17 - $0\frac{1}{4}$.
- X. At $\frac{3}{4}$ per lb. What cost 136? Facit £. 0 - 8 - 6.
- XI. At $\frac{1}{4}$ per lb. What cost 79? Facit £. 0 - 1 - $7\frac{3}{4}$.
- XII. At $\frac{1}{2}$ per lb. What cost 19? Facit £. 0 - 0 - $9\frac{1}{2}$.
- XIII. At $\frac{3}{4}$ per lb. What cost 46? Facit £. 0 - 2 - $10\frac{1}{2}$.
- XIV. At $8\frac{1}{2}d.$ per Yard. What cost 546? Facit £. 19 - 6 - 9.
- XV. At 6s. $6\frac{3}{4}d.$ per Ell. What cost 494? Facit £. 162 - 1 - $10\frac{1}{2}$.
- XVI. At £. 34 - 18 - $10\frac{1}{2}$ one, What will 376 cost? Facit £. 13138 - 17.
- XVII. At £. 17 - 13 - $9\frac{1}{2}$ one, What will 750 cost? Facit £. 13267 - 3 - 9.
- XVIII. At £. 8 - 7 - $7\frac{3}{4}$ one, What will 167 cost? Facit £. 1399 - 16 - $10\frac{1}{4}$.
- XIX. At £. 4 - 0 - $5\frac{3}{4}$ one, What will 500 cost? Facit £. 2011 - 19 - 7.
- XX. At $11\frac{1}{2}d.$ per Yard. What will 576 cost? Facit £. 27 - 12.
- XXI. At $10\frac{1}{4}d.$ per Yard. What will 900 cost? Facit £. 38 - 8 - 9.
- XXII. At $6\frac{1}{4}d.$ one, What will 700 cost? Facit £. 18 - 4 - 7.
- XXIII. At 17s. $8\frac{1}{4}d.$ one, What will 459 cost? Facit £. 405 - 18 - $6\frac{3}{4}$.
- XXIV. At 18s. $8\frac{1}{2}d.$ one, What will 640 cost? Facit £. 598 - 13 - 4.
- XXV. At 16s. $8\frac{3}{4}$ one, What will 471 cost? Facit £. 393 - 19 - $5\frac{1}{4}$.
- XXVI. At 8s. $4\frac{1}{2}$ one, What will 560 cost? Facit £. 234 - 10.
- XXVII. At 9s. $6\frac{3}{4}$ one, What will 450 cost? Facit £. 215 - 3 - $1\frac{1}{2}$.
- XXVIII. At 6s. $7\frac{1}{2}$ one, What will 900 cost? Facit £. 298 - 2 - 6.
- XXIX. At £. 4 - 8 - $10\frac{1}{2}$ one, What will 777 cost? Facit £. 3452 - 15 - $10\frac{1}{2}$.
- XXX. At £. 6 - 6 - $6\frac{3}{4}$ one, What will 979 cost? Facit £. 6195 - 4 - $8\frac{1}{4}$.
- XXXI. At £. $1\frac{1}{2}d.$ one, What will 378 cost? Facit £. 2 - 7 - 3.

CASE

PRACTICE.

101

CASE IV. When the Shillings and Pence in the Price are even Parts of a Pound.

RULE. Having found the Aliquot Part or Parts, divide by it or them, the Multiplicand; and, as it would not be easy to find directly those Aliquot or even Parts, it will be necessary to learn by Heart this

TABLE OF ALIQUOT PARTS OF 20s.

10s. 0d. = $\frac{1}{2}$	or the Half.				
6 8 = $\frac{1}{3}$	Third.	For			
5 0 = $\frac{1}{4}$	Fourth.	17s. 6d.	Sub. $\frac{1}{3}$ of the Quantity.		
4 0 = $\frac{1}{5}$	Fifth.	15	Subtract $\frac{1}{4}$		
3 4 = $\frac{1}{6}$	Sixth.	13 4	Subtract $\frac{1}{5}$		
2 6 = $\frac{1}{8}$	Eighth.	16 8	Subtract $\frac{1}{6}$		
1 8 = $\frac{1}{12}$	Twelfth.	19 4	Sub. the Value of 3d.		
1 3 = $\frac{1}{16}$	Sixteenth.		&c.		

ANOTHER TABLE.

EXAMPLES.

What cost 76 Yards of Holland at 10s. per Yard? Facit £. 38.

$$\begin{array}{r}
 10s. = \frac{1}{2} \text{ So, } 2) 76 \\
 \hline
 \text{£. } 38
 \end{array}
 \quad
 \begin{array}{r}
 \text{PROOF. } 7|6 \quad 5 \\
 \hline
 0 - 10 \\
 \hline
 \text{£. } 38 - 0
 \end{array}$$

What cost 342 Dozens of Candles at 6s. 8d. per Dozen? Facit £. 114.

$$\begin{array}{r}
 6s. 8d. = \frac{1}{3} \text{ So, } 3) 342 \\
 \hline
 \text{£. } 114
 \end{array}$$

Bought 33 Yards of Cloth at 15s. per Yard? Facit £. 24 - 15.

$$\begin{array}{r}
 20s. - 15 = 5 \text{ and } 5s. = \frac{1}{4} \text{ So, } 4) 33 \\
 \hline
 \text{Subtract } 8 - 5 \\
 \hline
 \text{£. } 24 - 15
 \end{array}$$

Bought 39 Gallons of Brandy at 13s. 4. Facit £. 26.

$$\begin{array}{r}
 20s. - 13 - 4 = 6s. 8d. \text{ and } 6s. 8d. = \frac{1}{3} \text{ So, } 3) 39 \\
 \hline
 \text{Subtract } - 13 \\
 \hline
 \text{£. } 26
 \end{array}$$

QUESTIONS TO EXERCISE THE LEARNER.

I. What cost 339 Bottles of Burgundy at 5s. per Bottle? Facit £. 84 - 15.

II. I spend 3s. 4d. a Day, What is it a Year (365 Days)? Facit £. 60 - 16 - 8.

III. At 1s. 8d. a Day, How much 46 Days? Facit £. 3 - 16 - 8.

IV. If

- IV. If 1 cost 16s. 8d. What will 353 cost? Facit £. 294 - 3 - 4.
 V. If 1 cost 8s. 4d. What will 268 cost? Facit £. 111 - 13 - 4.
 VI. At 19s. 4d. a Thing, What will 545 cost? Facit £. 526 - 16 - 8.
 VII. At 19s. 8d. one, What will 29 cost? Facit £. 28 - 10 - 4.
Subtract the Value of 4d.
 VIII. If 1 cost £. 5 - 6 - 8. What will 34 cost? Facit £. 181 - 6 - 8.
 IX. At 7s. 8d. one, What will 532 cost? Facit £. 203 - 18 - 8.
To the Product of 6s. 8d. add that of 1s.
 X. What cost 49 Pairs of Shoes at 4s. per Pair? Facit £. 9 - 16.
 XI. Bought 35 Grammars at Half a Crown a Piece. Facit £. 4 - 7 - 6.
 XII. Sold 59 Yards of Linnen at 15d. per Yard. Facit £. 3 - 13 - 9.
 XIII. If 1 cost 7s. 6d. What will 543 cost? Facit £. 203 - 12 - 6.
 XIV. If 1 cost 4s. 2d. What will 245 cost? Facit £. 51 - 0 - 10.
 XV. At 19s. 6d. one, What will 26 cost? Facit £. 25 - 7 - 0.
Subtract the Value of 6d.
 XVI. If 1 cost 11s. 8d. What will 43 cost? Facit £. 25 - 1 - 8.
 10s. = $\frac{1}{2}$ and 1s. 8d. = $\frac{1}{12}$; or, which will come to the same:
 5 = $\frac{1}{4}$ and 6s. 8d. = $\frac{1}{3}$
 XVII. At £. 7 - 13 - 4 one, What will 57 cost? Facit £. 437 - 0 - 0.
 XVIII. At 15s. 4d. What will 47 cost? Facit £. 36 - 0 - 8.
Subtract $\frac{1}{3}$, then add the Value of 2s.
 XIX. Paid 17s. 6d. for 1. What am I to pay for 769? Facit £. 672 - 17 - 6.

CASE V. When the given Price is an Aliquot Part of £. 10,
 or £. 100, or £. 1000, &c.

RULE. If an Aliquot Part of ten Pounds, annex a Cypher to the given Quantity: If an Aliquot Part of a Hundred, annex two Cyphers: If an Aliquot Part of a Thousand, annex three Cyphers: and so on. Afterwards, take the Aliquot Part or Parts; (See CASE I. in Division of Whole Numbers, Note II. in *Supplement to Contractions in Multiplication*) and for more Ease follow these

TABLES OF ALIQUOT PARTS

Of 10 Pounds.	Of 100.	Of 1000.
£. 0 - 12 - 6 = $\frac{1}{10}$	6 - 5 - 0 = $\frac{1}{16}$	62 - 10 - 0 = $\frac{1}{16}$
1 - 5 - 0 = $\frac{1}{20}$	12 - 10 - 0 = $\frac{1}{8}$	125 - 0 - 0 = $\frac{1}{8}$
2 - 10 - 0 = $\frac{1}{5}$	25 - 0 - 0 = $\frac{1}{4}$	250 - 0 - 0 = $\frac{1}{4}$
5 - 0 - 0 = $\frac{1}{2}$	50 - 0 - 0 = $\frac{1}{2}$	500 - 0 - 0 = $\frac{1}{2}$
2 - 0 - 0 = $\frac{1}{5}$	20 - 0 - 0 = $\frac{1}{5}$	200 - 0 - 0 = $\frac{1}{5}$
0 - 16 - 8 = $\frac{1}{12}$	8 - 6 - 8 = $\frac{1}{12}$	83 - 6 - 8 = $\frac{1}{12}$
1 - 13 - 4 = $\frac{1}{7}$	16 - 13 - 4 = $\frac{1}{7}$	166 - 13 - 4 = $\frac{1}{7}$
3 - 6 - 8 = $\frac{1}{3}$	33 - 6 - 8 = $\frac{1}{3}$	333 - 6 - 8 = $\frac{1}{3}$

N. B. If

PRACTICE.

163

N. B. If the given Price is not to be found in any of the Tables, make use of that Aliquot Part which is the nearest equal to the said Price; then for the Overplus either add, or Subtract, or multiply, or take such Part or Parts as may properly be made use of to answer your Purpose.

EXAMPLES.

What cost 68 at 12s. 6d. one? Facit £. 42 - 10.
 12s. 6d. = $\frac{1}{16}$ of £. 10, So, 16) 680 (42 - 10
 What cost 75 at £. 16 - 13 - 4 one? Facit £. 1250.
 £. 16 - 13 4 = $\frac{1}{8}$ of £. 100, So, 8) 7500 (1250
 What cost 64 at £. 13 - 6 - 8 one? Facit £. 853 - 6 - 8.
 £. 3 - 6 - 8 = $\frac{1}{3}$ of £. 10, So, 640 + $\frac{1}{3}$ = 853 - 6 - 8.
 What cost 94 at £. 66 - 13 - 4 one? Facit £. 6266 - 13 - 4.
 £. 33 - 6s. 8d. = $\frac{1}{3}$ of £. 100
 So, 9400 ÷ 3 = $\begin{array}{r} 3133 - 6 - 8 = 33 - 6 - 8 \\ 3133 - 6 - 8 = 33 - 6 - 8 \\ \hline 6266 - 13 - 4 = 66 - 13 - 4 \end{array}$

QUESTIONS TO EXERCISE THE LEARNER.

- I. What cost 49, at £. 2 - 10? Facit £. 122 - 10.
- II. What cost 630, at £. 12 - 10? Facit £. 7875.
- III. What do 46 come to, at £. 1 - 13 - 4 one? Facit 76 - 13 - 4.
- IV. What is the Product of 54, at £. 3 - 6 - 8? Facit £. 180.
- V. What cost 136, at £. 6 - 13 - 4? Facit £. 906 - 13 - 4.
- VI. At £. 1 - 5s. a Thing; What will 745 cost? Facit £. 931 - 5.
- VII. At £. 15 one, What will 45 cost? Facit £. 675.
 $\begin{array}{r} 2) 450 = 10 \\ 225 \end{array} \} 675.$
- VIII. At £. 11 - 5 one; What cost 72? Facit £. 810.
 $\begin{array}{r} 1 - 5s = 8) 72.0 = 10 \\ 90 \end{array} \} 810.$
- IX. What cost 60, at £. 11 - 13 - 4? Facit £. 700.
 $\begin{array}{r} 1 - 13 - 4 = 6) 600 \\ 100 \end{array} \} 700.$
- X. What cost 74, at £. 33 - 6 - 8? Facit £. 2466 - 13 - 4.
- XI. What cost 46, at £. 133 - 6 - 8? Facit £. 6133 - 6 - 8.
 $\begin{array}{r} 33 - 6 - 8 \text{ of } 100 = 3) 4600 \\ 1533 - 6 - 8. \end{array} \} 6133 - 6 - 8.$
- XII. What cost 84, at £. 166 - 13 - 4? Facit £. 14000.
- XIII. What cost 94, at £. 4 - 16 - 8? Facit 454 - 6 - 8.
 $\begin{array}{r} 16s. 8 = 12) 940 (78 - 6 - 8 \\ 94 \times 4s. = 376 - 0 - 0 \end{array} \} £. 454 - 6 - 8.$
- XIV. What cost 59, at £. 8 - 6 - 8? Facit £. 491 - 13 - 4.
- XV. What cost 78, at £. 66 - 15 - 4? Facit £. 5207 - 16.
work as for £. 33 - 6 - 8. twice, and for 2s.

XVI. What

XVI. What cost 47, at £ 8 - 6 - 10? Facit £. 392 - 1 - 2.
work as for 8 - 6 - 8, and as for 2d.

XVII. What cost 678, at £. 36 - 13 - 4? Facit £. 24860.
work as for 16 - 13 - 4, and as for 20 £.

XVIII. What cost 45, at £. 26 - 13 - 4? Facit £. 1200.
work as for 16 - 13 - 4, and as for 10.

XIX. What cost 36, at £. 53 - 5 - 8? Facit £. 1920.
work as for 3 - 6 - 8, and as for 50.

XX. What cost 52, at £. 8 - 6 - 8? Facit £. 433 - 6 - 8.

XXI. What cost 49, at £. 5? Facit £. 245.

XXII. What cost 34, at £. 266 - 13 - 4? Facit £. 9066 - 13 - 4.
work as for 166 - 13 - 4, and as for 100.

XXIII. What cost 24, at £. 4 - 3 - 4? Facit £. 100.
work as for 8 - 6 - 8, then take the Half.

XXIV. What cost 24, at £. 18 - 6 - 8? Facit £. 440.
work as for 8 - 6 - 8, and as for 10.

XXV. What cost 79, at £. 25? Facit £. 1975.

XXVI. What cost $54\frac{1}{2}$, at £. 3 - 6 - 8? Facit £. 181 - 13 - 4.
instead of annexing 0, annex 5 for the Half, as the Half of 10 is 5.

XXVII. What cost $65\frac{1}{4}$, at £. 16 - 13 - 4. Facit £. 1087 - 10.
instead of annexing 00, annex 25 for the $\frac{1}{4}$, as the Fourth of 100 = 25.

CASE VI. When a given Weight consists of several Denominations.

RULE. Take in the given Price, or Multiplier, proportional Parts, which may be readily found, after having carefully committed to Memory the three following Tables:

Table I.	Table II.	Table III.
Even Parts of a Tun.	Even Parts of a Cwt.	Even Parts of a Qr.
Cwts. qrs.	lbs. qrs. lbs.	lbs.
10 - 0 = $\frac{1}{2}$	56, or 2 - 0 = $\frac{1}{2}$	14 = $\frac{1}{2}$
5 - 0 = $\frac{1}{4}$	28, or 1 - 0 = $\frac{1}{4}$	7 = $\frac{1}{4}$
4 - 0 = $\frac{1}{5}$	0 - 16 = $\frac{1}{7}$	4 = $\frac{1}{7}$
2 - 2 = $\frac{1}{3}$	0 - 14 = $\frac{1}{8}$	$3\frac{1}{2}$ = $\frac{1}{8}$
2 - 0 = $\frac{1}{10}$	0 - 8 = $\frac{1}{14}$	
1 - 1 = $\frac{1}{10}$	0 - 7 = $\frac{1}{16}$	
1 - 0 = $\frac{1}{20}$		

Question I. 19 Tuns, 11 Cwts, 3 qrs. 26lbs. at £. 14 per Tun; How much does the Whole come to? Facit £. 274 - 7 - 9.

II. Bought 42cwt. 2qrs. 19lbs. of Currants, at £. 2 - 15 - 4, per cwt. Facit £. 118 - 1 - 0 $\frac{1}{2}$ $\frac{4}{7}$.

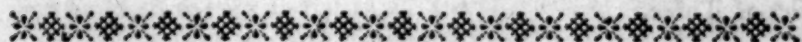
III. Bought 112cwt. 3qrs. 6lbs. of Cheese, at £. 1 - 7 - 10 $\frac{1}{2}$. Facit £. 157 - 4 - 4 $\frac{3}{4}$.

12 JU 62

THE END OF THE SECOND PART.

THE THIRD PART.

VARIETIES in PROPORTION.



THE RULE OF FIVE;

Or,

COMPOUND and DOUBLE RULE OF THREE.

TEACHETH to find a sixth Proportional to five given Numbers, three of which are a Supposition, and the other two are a Demand; that sixth is properly found by working two Rules of Three, the Answer of whose last is that required*.

Note I. In any Question of this Rule, there are always two Numbers in the Supposition of the same Name or signifying the same Thing with the two Numbers in the Demand.

Note II. In both Rules of Three, the said two Numbers in the Supposition are always to be either first or second Terms, and the two Numbers in the Demand are always to be the third Terms.

RULE. *In the first Rule of Three, place, for first Term, either of the two Numbers of the Supposition, which are of the same Name or signify the same Thing with the two Numbers of the*

* Some Authors give Rules to work the Double Rule of Three by a single Stating: but their Rules proving insufficient, it is better never to make Use of them.

P

Demand;

Demand; for second Term, that Number of the Supposition the like of which is not in the two Numbers of the Demand, but which is of the same Name with the sixth proportional Sought; and for third Term, that Number of the Supposition which is of the same Name or signifies the same Thing with that you have placed for first Term. Then, work as directed for the single Rule of Three.

In the second Rule of Three, place, for first Term, that Number of the Supposition which has not been made Use of; for second Term, the Answer of the first Rule of Three; and for third Term, that Number of the Demand which has not been made Use of in the first Rule of Three. Then, again work as directed for the single Rule of Three.

Observe, that the first Term must always be of the same Name or signify the same Thing with the third; and that the Name in which the Answer is required, must be the middle Term in both Rules of Three.

EXAMPLE.

If in 5 Days 10 Men earn £. 100; what, in the same Proportion, may 25 Men earn in 15 Days? Facit £. 750.

For the first Rule of Three, making Men (Name significantly mentioned both in the Supposition and in the Demand) the first and third Terms; and placing Pounds (the Quantity of which is sought by the Demand) for the Middle Term:

First, I say: If 10 Men earn £. 100; what may 25 Men earn? Facit £. 250.

As 10 m. : £. 100 :: 25 m. : Abbreviated, As 1 m. : £. 10 :: 25 m. : So, $25 \times 100 = 2500 \div 10 = 250$ So, $25 \times 10 = 250$

For the second Rule of Three, making Days (Name significantly mentioned both in the Supposition and in the Demand) the first and third Terms; and placing the Answer of the first Rule of Three, viz, £. 250 (Name whose Quantity is sought by the Demand) for the Middle Term:

Secondly, I say: If in 5 Days £. 250 are earned; How many Pounds may be earned in 15 Days? Facit £. 750. Answer required.

As 5 d. : £. 250 :: 15 d. : Abbreviated, As 1 d. : £. 250 :: 3 d. So, $250 \times 15 = 3750 \div 5 = 750$ So, $250 \times 3 = 750$

Or, which may serve for PROOF to the other.

For the first Rule of Three, making Days (Name significantly mentioned both in the Supposition and in the Demand) the first and third Terms; and placing Pounds (the Quantity of whose Name is sought by the Demand) for the Middle Term:

First, I say: If in 5 Days £. 100 are earned, How many Pounds may be earned in 15 Days? Facit £. 300.

As

RULE OF HUNDRED. 107

As 5 *d.* : £. 100 :: 15 *d.* : Abbreviated, As 1 *d.* : £. 100 :: 3 *d.* :
 So, $100 \times 15 = 1500 \div 5 = 300$ So, $100 \times 3 = 300$

For the second Rule of Three, making Men (Name significantly mentioned both in the Supposition and in the Demand) the first and third Terms; and placing the Answer of the first Rule of Three, viz. £. 300 (Name whose Quantity is sought, as appears by the Demand) for the Middle Term:

Secondly, I say: If 10 Men earn £. 300, What may 25 Men earn? Facit £. 750. Answer required.

As 10 *m.* : £. 300 :: 25 *m.* : Abbreviated, As 1 *m.* : £. 30 :: 25 *m.* :
 So, $25 \times 300 = 7500 \div 10 = 750$ So, $25 \times 30 = 750$

QUESTIONS TO EXERCISE THE LEARNER.

I. If 10 Men in 5 Days earn £. 100; in how many Days may 25 Men earn £. 750. Facit 15 Days.

II. If to earn £. 100, 10 Men work 5 Days, how many Men must be hired to earn £. 750 in 15 Days? Facit 25 Men.

III. If 500 Men working 14 Hours a Day can do a certain Work in 25 Days, In how many Days may 1400 Men perform the same, working only 12 Hours a Day? Facit 10 Days + $\frac{15}{12}$.

IV. If £. 16 pay the Carriage of 20 Packs 136 Miles, What will the Carriage of 12 Packs come to, for 28 Miles? Facit £. 1 - 19 - 6 $\frac{1}{4}$ + $\frac{56}{136}$.

V. If 600 Seamen in 1 Week eat 13 *cwt.* 1 *qr.* 16 *lbs.* of Beef, How many *lbs.* will serve 120 Seamen 12 Weeks? Facit 3600 *lbs.*



RULE OF HUNDRED *.

CASE I. To know the Price of a Hundred, the Price of 1 being given.

RULE. Multiply the Price by 100. OR, if the Price be in Shillings only, then, considering the Shillings as Pounds, multiply them by 5, and the Product will be the Answer in Pounds: if the Price be in Pounds, bring the Pounds into Shillings, then multiply as above by 5: if the Price be in Pence, take Part or Parts of £. 5, proportionally to a Shilling, that is to say: if 6*d.* take the Half of £. 5; if 3*d.* take the Fourth; if 4*d.* take the Third; if 2*d.* take the Sixth, &c. as in Practice, where see the first Table for Pence, having the Product of 15.

* This is applicable only to a common Hundred (100), and not to a long Hundred, wherein are 120 instead of 100; nor to a Hundred *lbs.* Weight, where in are 112 instead of 100.

EXAMPLES.

I. At 19s. a Thing, What cost 100? Facit £. 95.

Common Way.

19s.

100

2|0) 190|0s.

£. 95

New Way.

19

5

£. 95

II. At £. 4 - 17 a Thing, What cost 100? Facit £. 485.

 $£. 4 - 17 = 97s. \times 5 = 485$

III. At 7d. a Thing, What cost 100? Facit £. 2 - 18 - 4.

6d. = the Half of £. 5 or - - - - -

£. 2 - 10 - 0

1d. = the Sixth of 6d. so, £. 2 - 10 ÷ 6 = 0 - 8 - 4

2 - 18 - 4.

IV. At £. 1 - 17 - 3 a Thing, What cost 100? Facit £. 186 - 5.

*Reduce the Pounds into Shillings and the Pence into the Aliquot**Part of a Shilling; thus, $37\frac{1}{4} \times 5 = £. 186 + \frac{1}{4}$ or 5s.*

QUESTIONS.

I. If *per* Yard I gain 6d. What shall I gain upon 100? Facit £. 2 - 10.II. If I lose 8d. *per* Yard, What shall I lose upon 100? Facit £. 3 - 6 - 8.

III. If I paid £. 2 - 13 - 6 for a Runlet of Wine, What will 100 cost? Facit £. 267 - 10.

IV. Bought 100 Yards of Ribbon at 9d. *per* Yard, What does the Whole come to? Facit £. 3 - 15.

N. B. When the Question is, how much a Thousand? Then, multiply by 1000 instead of 100, or rather by 50 instead of 5.

At £. 1 - 17 - 3 one, How much 1000? Facit £. 1862 - 10.

 $£. 1 - 17 - 3 = 37\frac{1}{4}$

10

Or thus, $37\frac{1}{4}$

50

372 $\frac{1}{2}$

5

1850

 $\frac{1}{4}$ of 50 = 12 - 101862 + $\frac{1}{4}$ or 10s.

1862 - 10

CASE II. To know the Price of 1, the Price of a Hundred being given.

RULE. Reduce the Price if required, and divide each Denomination by 100; or, instead of dividing by 100, cut off 2 Figures Right-Hand; those Left-Hand will be Pounds. Then, the said two Figures Right-Hand, if significant ones, reduce to the next lower Denomination, *viz.* Shillings, cut off again two Figures Right-

RULE OF HUNDRED. 109

Right-Hand; those Left-Hand will be Shillings. And so on, for Pence and Farthings. OR RATHER, after having found; as above, the Pounds; consider the remaining Figures Right-Hand as Shillings, and take the fifth Part in them. Thus, in one Line, you will have Pounds, Shillings, Pence, and Farthings. But, as it often happens that the Sum to be divided is applicate, in such Case you may still work, with the Pounds in the Price of a Hundred, by Contraction as before directed; then, for the Shillings and Pence annexed to the given Price of a Hundred (considering that 20s. divided by 100 = 2d. $\frac{1}{2}$ + $\frac{1}{2}$), add to the Quotient a Farthing for every two or nearly two Shillings (but not above 6d. under), which in Business will fully answer the Purpose, since 1s. does not produce the Half of a Farthing*.

EXAMPLES.

I. If 100 cost £. 34, What will 1 cost? Facit 6s. 9 $\frac{1}{2}$ d. + $\frac{1}{2}$ d.

Common Way.	{	34	New Way. Considering £. 34 as 34s. Say: the fifth in 34s. is 6s. 9 $\frac{1}{2}$ d. + $\frac{1}{2}$ d.
		20	
		680	
		12	
		960	
		4	
		2140	

II. If 100 cost £. 354, What will 1 cost? Facit £. 3 - 10 - 9 $\frac{1}{2}$.

$$\begin{array}{r} 354 \div 5 \\ \hline \end{array} \quad \text{£. 3 - 10 - 9 } \frac{1}{2} + \frac{1}{2}$$

* This Contraction takes its Ground from what has been observed in Reduction, viz. that when a Quantity is to be either multiplied by a Number, then divided by another; or, divided by a Number, then multiplied by another, both the Multiplier and the Divisor should be contracted, if possible. Here, the Pounds to be brought to Shillings should be multiplied by 20: but as afterwards they are to be divided by 100, so, contracting both Factors 20 and 100 thus;

2) $\frac{20}{100}$ ($\frac{1}{5}$ Multiplier, I conclude, that only to divide by 5 the Pounds considered as Shillings, it is the same as if I should multiply the Pounds by 20 and divide the Product by 100. By the same Reason did I only multiply by 5 in the last Case, it being the Reverse of this,

III. If

110 RULE OF HUNDRED.

III. If 100 cost £. 354 - 17 - 4 $\frac{3}{4}$, What will 1 cost? Facit

£. 3 - 10 - 11 $\frac{1}{2}$.

£. 354

20 + 17

10197

12 + 4

11168

4 + 3

2175

New Way.

3154 ÷ 5

£. 3 - 10 - 9 $\frac{1}{2}$ +

For 17s. add . . . 2

£. 3 - 10 - 11 $\frac{1}{2}$

QUESTIONS.

I. If 100 cost £. 48 - 10, What cost 1? Facit 9s. 8 $\frac{1}{2}$ d. +

II. If 100 cost £. 34 - 14 - 6, What cost 1? Facit 6s. 11 $\frac{1}{4}$ d. +

III. If 100 cost £. 0 - 15 - 9, What will 1 come to? Facit 1 $\frac{3}{4}$ d. +

CASE III. The Price of 100 being given, to know what any Quantity will come to.

RULE. Multiply the Price by the Quantity, and the Product divide by 100, or by 5, as before directed.

EXAMPLE.

If 100 cost £. 54 - 14 - 9, What will 547 come to? Facit

£. 299 - 8 - 3 $\frac{1}{4}$.

54 | 7 7

54 - 14 - 9

2188

2735 .

382 - 18

13 - 13 - 6 = 6d.

6 - 16 - 9 = 3d.

29941 - 8 - 3

299 | 416 ÷ 5

£. 299 - 8 - 2 $\frac{1}{4}$ +

8s. =

299 - 8 - 3 $\frac{1}{4}$

QUESTIONS.

I. If 100 cost £. 49, What will 356 come to? Facit £. 174 - 8 - 9 $\frac{1}{2}$.

II. If I paid £. 36 - 10 for 100, What will 9 come to? Facit

£. 3 - 5 - 8 $\frac{1}{4}$.

III. If with £. 100 I get £. 20, What shall I get with 254 - 17 - 6? Facit £. 50 - 19 - 6.

INTEREST.

F11

INTEREST.

There are two Kinds of *Interest*, viz. *Simple* and *Compound*.

Simple Interest, is the Profit allowed for lending any Sum of Money for a determined Space of Time.

Compound Interest (otherwise, *Interest upon Interest*), is the Profit that arises from any Sum and its Interest put together, as the Interest still becomes due.

The *Principal* is any Sum of Money lent, for which, Interest at a certain Rate is received.

The *Rate per Cent* is a certain Sum agreed on between the Lender and Borrower, to be paid for every £. 100, for 1 Year.

The *Amount* is the Principal and Interest added together.

SIMPLE INTEREST.

CASE I. TO FIND THE INTEREST; *Principal*, *Time*, and *Rate* being given.

RULES, I. If for 1 Year only, multiply the Principal by the Rate, and divide the Product by 100, or rather by 5, as in CASE II. of the Rule of Hundred.

II. If for *several Years*, multiply the Principal by the Number of Years, the Product by the Rate; then divide by 100, or by 5 as before directed: or, multiply the Rate by the Time, and by the Product of this multiply likewise the Principal; then divide either by 100, or by 5, as before directed.

III. When the Interest is required for any Number of *Months*, find the Interest of one Year; then, since 12 Months = 1 Year, for the Months take the Aliquot Part or Parts they make in 12.

IV. When the Interest is required for any Number of *Weeks*, find the Interest of one Year; then, as there are 52 Weeks in a Year, state and work a Rule of Three, thus: As 52 Weeks are to one Year's Interest, so the Weeks given are to the Interest required.

V. When the Interest is required for any Number of *Days*, find the Interest of one Year; then, allowing 365 Days to a Year, state and work a Rule of Three, thus: As 365 Days are, to one Year's Interest, so the Days given are to the Interest required. Or, when the Interest is at 5 per Cent. multiply the Principal by the Number of Days, and the Product divide by 7300; and if the Interest is at a lower or higher Rate than 5 per Cent. in the Quotient of the Product divided by 7300, take Part or Parts for the Difference, and add or subtract accordingly.

NOTE

NOTE I. When the Rate is an Aliquot Part of 100, it will prove still more expeditious to work according to the following Table.

At 50 per Cent. take the <i>Half</i> .	At 10 per Cent. take the <i>Tenth</i> .
25 - - - the <i>Fourth</i> .	5 the <i>Half</i> of the Prod. of the <i>Tenth</i> .
20 - - - the <i>Fifth</i> .	2 the <i>Fifth</i> of the Prod. of the <i>Tenth</i> .

NOTE II. When the Principal consists of even Hundreds only, multiply the Number of Hundreds by the Rate, and the Product will be the Interest required.

EXAMPLES.

I. What is the Interest of £. 346 - 17 - 4, at 5 per Cent.? Facit £. 17 - 6 - 10 $\frac{1}{4}$.

£. 346 - 17 - 4
5

17|34 - 6 - 8

20

6|86

12

10|40

4

1|60

New Way £. 346 - 17 - 4

5

17|34 - 6 - 8

£. 17 - 6 - 9 $\frac{1}{4}$ +

For 6s. add - - - $\frac{1}{4}$

£. 17 - 6 - 10 $\frac{1}{4}$

II. What is the Interest of £. 224, at 4 $\frac{3}{4}$ per Cent. Facit £. 10 - 12 - 9 $\frac{1}{2}$.

224

4

896

$\frac{3}{4} = \frac{1}{2}$ of 224, 112

$\frac{1}{4} = \frac{1}{2}$ of 112, 56

10|64

£. 10 - 12 - 9 $\frac{1}{2}$ + $\frac{1}{2}$.

III. What is the Interest of £. 436 - 4 - 5, for 4 Years, at 5 per Cent. per Annum.? Facit £. 87 - 4 - 10 $\frac{1}{2}$.

436 - 4 - 5

4 Years.

1744 - 17 - 8

5 per Cent.

87|24 - 8 - 4

£. 87 - 4 - 10 - $\frac{1}{2}$ +

Or, thus:

4 Years $\times$ 5 per Cent. = 20

and 20 in 100 = $\frac{1}{5}$

So,

5)436 - 4 - 5

£. 87 - 4 - 10 $\frac{1}{2}$ + $\frac{1}{2}$.

IV. What

SIMPLE INTEREST.

113

IV. What is the Interest of £.576 - 10, for 9 Months, at 4 per Cent. per Annum? Facit £.17 - 5 - 10 $\frac{3}{4}$.

£.576 - 10

4 per Cent.

23|06 - 0

1 Year = £.23 - 1 - 2 $\frac{1}{4}$ + $\frac{3}{4}$

6 Months = $\frac{1}{2}$ 11 - 10 - 7 — $\frac{4}{5}$

3 - - = $\frac{1}{4}$ of 6 5 - 15 - 3 $\frac{1}{2}$ $\frac{2}{5}$

9 Months = 17 - 5 - 10 $\frac{3}{4}$ $\frac{1}{5}$

V. What is the Interest of £.255, for 4 Years, 6 Months, at 5 $\frac{1}{2}$ per Cent. per Annum? Facit £.60 - 4 - 10 $\frac{1}{2}$.

255

5 $\frac{1}{2}$

$\frac{1}{4}$ = - - 1275
63 - 15

13|38 - 15

1 Year = £.13 - 7 - 9 taking, in the 36 Pence, 9 for

3 - = - 40 - 3 - 3 the 15s.

6 Months = 6 - 13 - 10 $\frac{1}{2}$

£.60 - 4 - 10 $\frac{1}{2}$

VI. What is the Interest of £.354 for 3 Weeks at 4 per Cent. per Annum? Facit 16s. 4d.

354

4

14|16

1 Year's Interest = £.14 - 3 - 2 $\frac{1}{4}$ + $\frac{3}{4}$

So, as 52 W. : £.14 - 3 - 2 $\frac{1}{4}$ $\frac{3}{4}$:: 3 W. :

3

52) 42 - 9 - 7 $\frac{3}{4}$ $\frac{3}{4}$ (£.0 - 16 - 4

20

849

329

17

12

211

3 This Rem. would not produce a Farthing.

Q

VII. What

SIMPLE INTEREST.

VII. What is the Interest of £. 284 for 4 Weeks at £. 4 per Cent. per Annum? Facit 17s. 5 $\frac{1}{2}$ d.

£. 284

4 per Cent.

11|36

13) 11 - 7 - 2 $\frac{1}{4}$ + = 1 Year's Interest.

4 Weeks = 0 - 17 - 5 $\frac{1}{2}$ +

As it is 4 Weeks, I don't multiply by the 4 Weeks and divide by 52; but only divide the Interest of 1 Year by 13.

VIII. What is the Interest of £. 435 - 15 for 13 Weeks at 5 per Cent. per Annum? Facit £. 5 - 18 - 11 $\frac{1}{2}$.

£. 435 - 15

5 per Cent.

21|77 - 15

4) 21 - 15 - 6 $\frac{1}{2}$ = 1 Year's Interest.

13 Weeks = 5 - 8 - 10 $\frac{1}{2}$.

As it is 13 Weeks, I don't multiply by 13 and divide by 52; but only divide the Interest of 1 Year by 4.

IX. What is the Interest of £. 360 for 120 Days at 4 per Cent. per Annum? Facit £. 4 - 14 - 8.

£. 360

4

Or thus,

36|0

12|0

14|40

14 - 8 = 1 Year's Interest.

365 d. : £. 14 - 8 :: 120 d.

10

144

12

10 x 12 = 120

365) 1728 (4 - 14 - 8

268

20

5360

1710

250

12

3000

80

£. 4 - 14 - 8

73|00

432|00

67

20

1340

610

26

12

312

20

4

80

7

From £. 5 - 18 - 4 $\frac{1}{4}$ Interest at 5 per Cent.

Sub. $\frac{1}{5}$ = 1 - 3 - 8 + Difference between 4 and 5.

X. What

SIMPLE INTEREST. 115

X. What is the Interest of £.240, for 3 Years 75 Days, at 5 per Cent. per Annum? Facit £. 38 - 9 - 3 $\frac{3}{4}$.

365 Days in a Year.

3 Years + 75 Days,

$$240 \times 1170 = 280800 \div$$

$$7300 = £. 38 - 9 - 3 \frac{3}{4} + \frac{1}{2}$$

1170 Days.

QUESTIONS.

I. What is the Interest of £.672, for a Year, at 5 per Cent. Facit £.33 - 12 - 0.

II. What is the Interest of £.456 - 10, for a Year, at 6 per Cent. Facit £.27 - 7 - 9 $\frac{1}{2}$.

III. What is the Interest of £.354, for a Year, at 4 per Cent. Facit £.14 - 3 - 2 $\frac{1}{4}$.

IV. What is the Interest of £.542, for a Year, at 3 per Cent. Facit £.16 - 5 - 2 $\frac{1}{4}$.

V. What is the Interest of £.543, for a Year, at 2 $\frac{1}{2}$ per Cent. Facit £.13 - 11 - 6.

VI. What is the Interest of £.243 - 15 - 6, for a Year, at 4 $\frac{1}{2}$ per Cent. Facit £.10 - 19 - 4 $\frac{3}{4}$.

VII. What is the Interest of £.454, for a Year, at 5 $\frac{1}{2}$ per Cent. Facit £.24 - 19 - 4 $\frac{3}{4}$.

VIII. What is the Interest of £.125, for a Year, at 5 $\frac{1}{4}$ per Cent. Facit £.6 - 11 - 3.

IX. What is the Interest of £.354 - 15 - 6, for 6 Years, at 5 per Cent. per Annum? Facit £.106 - 8 - 7 $\frac{3}{4}$.

X. What is the Interest of £.233, for 3 Years, at 3 per Cent. per Annum? Facit £.34 - 19.

XI. What is the Interest of £.246 - 15, for 3 Months, at 4 per Cent. per Annum? Facit £.2 - 9 - 4.

XII. What is the Interest of £.343, for 4 Months, at 5 per Cent. per Annum? Facit £.5 - 14 - 4.

XIII. What is the Interest of £.342, for 8 Months, at 3 $\frac{1}{2}$ per Cent. per Annum? Facit £.7 - 19 - 7.

XIV. What is the Interest of £.145, for 2 Years 6 Months, at 4 per Cent. per Annum? Facit £.14 - 10.

XV. What is the Interest of £.354, for 3 Weeks, at 4 per Cent. per Annum? Facit 16s. 4d.

XVI. What is the Interest of £.400, for 45 Weeks, at 4 per Cent. per Annum? Facit £.13 - 16 - 11.

XVII. What is the Interest of £.396 - 10, for 15 Weeks, at 5 per Cent. per Annum? Facit £.5 - 14 - 4 $\frac{1}{2}$.

XVIII. What is the Interest of £.547 - 15, at 5 per Cent. for 320 Days? Facit £.24 - 0 - 2 $\frac{1}{2}$.

XIX. What is the Interest of £.248 - 19, for 175 Days, at 4 per Cent. Facit £.4 - 15 - 5 $\frac{1}{2}$.

Q 2

XX. What

XX. What is the Interest of £. 150, from the 18th (excluded) Day of January, to the 11th (included) of November, at $4\frac{3}{4}$ per Cent. Facit £. 5 - 15 - 11 $\frac{3}{4}$.

CASE II. TO FIND THE PRINCIPAL, the *Amount*, *Time* and *Rate* being given.

RULE. As Time $\times$ Rate $\div$ 100 : 100 :: the Amount given : the Principal required.

EXAMPLES.

I. What Principal in 4 Years, at 5 per Cent. per Annum, will amount to £. 240? Facit £. 200.

$4 \text{ Years} \times 5 \text{ Rate} \div 100 = 120$, Therefore,
As 120 : 100 :: 240 Contracted, as 1 : 100 :: 2

12|0) 2400|0
200

£. 200

II. What Principal in $2\frac{1}{2}$ Years at 4 per Cent. per Annum, will amount to £. 159 - 10? Facit £. 145.

$2\frac{1}{2} \text{ Years} \times 4 \text{ Rate} \div 100 = 110$, Therefore,
As 110 : 10|0 :: 159 - 10 Contracted, as 1 : $1 - \frac{1}{11}$:: 159 - 10
10 So, Subtract - - $\frac{1}{11} = 14 - 10$

11) 1595 - 0
£. 145

£. 145 - 0

III. What Principal being put to Interest for 9 Years, will amount to £. 734 - 8 at 4 per Cent. per Annum? Facit £. 540.

IV. What Principal being put to Interest for 7 Years at 5 per Cent. per Annum, will amount to £. 334 - 16? Facit £. 248.

CASE III. TO FIND THE TIME, the *Principal*, *Rate* and *Amount* being given.

RULE. Subtract the Principal from the Amount. Then, as the Interest of the Principal for 1 Year : 1 Year :: the Remainder or whole Interest : the Time required.

EXAMPLES.

I. In what Time will £. 200 amount to £. 240 at 5 per Cent. per Annum? Facit 4 Years.

From . £. 240 Interest of the Principal £. 200
Take the Principal 200

for 1 Year is . £. 10

Remainder . . 40 or Whole Interest.

Now, say: as £. 10 Interest : 1 Year :: £. 40 Interest :
1|0) 4|0

II. In

SIMPLE INTEREST, 117

II. In what Time will £. 145 amount to £. 159 - 10, at 4 per Cent. per Annum? Facit $2\frac{1}{2}$ Years.

$$\begin{array}{r} \text{£. 159 - 10} \\ - 145 \\ \hline \end{array} \quad \begin{array}{r} 145 \\ 4 \end{array}$$

Whole Interest £. 14 - 10

$$\begin{array}{r} 5180 \end{array}$$

£. 5 - 16 Interest of 1 Year.

As £. 5 - 16 : 1 Year :: £. 14 - 10 116) 290 ($2 + \frac{58}{116} = \frac{3}{2}$

$$\begin{array}{r} 20 \end{array}$$

$$\begin{array}{r} 20 \end{array}$$

$$\begin{array}{r} 58 \end{array}$$

116s. : 1 Year :: 290s. :

III. In what Time will £. 540 amount to £. 734 - 8, at 4 per Cent. per Annum? Facit 9 Years.

IV. In what Time will £. 248 amount to £. 334 - 16, at 5 per Cent. per Annum? Facit 7 Years

CASE IV. TO FIND THE RATE, the Amount, Time and Principal begin given.

RULE. Subtract the Principal from the Amount; and then, as the Principal: the Remainder or whole Interest :: 100 : A Rate, which, divided by the Time, gives the Rate required.

EXAMPLES.

I At what Rate per Cent. will £. 200 amount to £. 240, in 4 Years? Facit 5 per Cent.

From the Amount £. 240 }
Take the Principal 200 } Remainder 40 or Whole Interest.

As £. 200 : 40 Interest :: 100 :

So, 2) 40 and 4 Years) 20

$$\begin{array}{r} 20 \end{array}$$

5 Rate required.

II. At what Rate per Cent. will £. 145 amount to £. 159 - 10, in $2\frac{1}{2}$ Years? Facit 4 per Cent.

III. At what Rate per Cent. will £. 248 amount to £. 334 - 16, in 7 Years Time? Facit 5 per Cent.

IV. At what Rate per Cent. will £. 540 amount to £. 734 - 8, in 9 Years Time? Facit 4 per Cent.

COMPOUND INTEREST.

RULE. Find the first Year's Interest, which add to the Principal, and the Total will be a new Principal for the second Year. Then find the Interest of that Sum which add as before, and the Total will be a new Principal for the third Year: Thus, proceed for any Number of Years; and if the Time is fractional, take Part or Parts of the last Amount, and add.

If

118 COMPOUND INTEREST.

If the *Compound Interest* only is required, subtract the *Principal* given from the last *Amount*, and the *Remainder* will be the *Answer*.

EXAMPLES.

I. What will £. 400 amount to in 4 Years, at 6 *per Cent. per Annum, Compound Interest*? Facit £. 504 - 19 - 9 $\frac{3}{4}$.

£. 400
6
Principal 400.

24|00

New Principal 424
6

25|44
25 - 8 - 9 $\frac{1}{2}$

N. P. 449 - 8 - 9 $\frac{1}{6}$

26|96 - 12 - 9

26 - 19 - 2 - $\frac{1}{4}$

12s. = . . . 1 - $\frac{1}{2}$

26 - 19 - 3 - 0 $\frac{3}{4}$

N. P. 476 - 8 - 1 $\frac{3}{6}$

28|58 - 8 - 10 $\frac{1}{2}$

28 - 11 - 7 - $\frac{1}{2}$

8s. = . . . 1 -

28 - 11 - 8 - $\frac{1}{2}$

24

1st Year 424

25 - 8 - 9 $\frac{1}{2}$

2d, 449 - 8 - 9 $\frac{1}{6}$

26 - 19 - 3 $\frac{3}{4}$

3d, 476 - 8 - 1 $\frac{1}{4}$

28 - 11 - 8 $\frac{1}{2}$

4th, £. 504 - 19 - 9 $\frac{3}{4}$

II. What Sum will £. 400 amount to in 4 Years, at 5 *per Cent. per Annum, Compound Interest*? Facit £. 486 - 4 - 0 $\frac{1}{2}$.

III. What is the *Compound Interest* of £. 500 forborne 3 Years, at 5 *per Cent. per Annum*? Facit £. 78 - 16 - 3.

The *Amount* for 3 Years is £. 578 - 16 - 3: but as *Compound Interest* only is required, so, the *Principal* £. 500 must be subtracted.

IV. What is the *Compound Interest* of £. 764, for 4 Years and 9 Months, at 6 *per Cent. per Annum*? Facit £. 243 - 18 - 8 $\frac{1}{2}$.

V. What will £. 100 amount to, if it be forborne 5 Years, at 5 *per Cent. per Annum, Compound Interest*? £. 127 - 12 - 6 $\frac{3}{4}$.

VI. What

COMMISSION and STOCK-JOBING. 119

VI. What will £. 20 amount to, forborne 7 Years, at 6 per Cent. Compound Interest? Facit £. 30 - 1 - 5 $\frac{1}{4}$.

N. B. On this Chapter I will treat more amply in Decimals.

COMMISSION

Is an Allowance at a certain Rate *per Cent.* to *Correspondents* or *Agents* in the Buying or Selling of Goods, or, for the *Disbursing* of any Sum.

RULE. Work as directed for *Simple Interest*.

EXAMPLES.

I. What is the Commission of £. 254, at 3 $\frac{1}{2}$ per Cent.? Facit £. 8 - 17 - 9 $\frac{1}{2}$.

$$\begin{array}{r} 254 \\ 3 \end{array}$$

$$\begin{array}{r} 8|89. \div 5 \\ \hline \text{£. } 8 - 17 - 9 \frac{1}{2} \end{array}$$

$$\frac{1}{2} = \frac{762}{127} \} 889$$

II. What must I allow my Factor for laying out for me £. 546 - 15, at 4 $\frac{1}{4}$ per Cent.? Facit £. 23 - 4 - 8 $\frac{3}{4}$.

III. Suppose I allow my Agent 1 $\frac{1}{2}$ per Cent. for Provision, what may he demand on the Disbursement of £. 84? Facit £. 1 - 9 - 4 $\frac{3}{4}$.

IV. My Correspondent sends me Word he has bought Goods to the Amount of £. 125 - 5, upon my Account, What does the Commission come to at 1 per Cent.? Facit £. 1 - 5 - 0 $\frac{1}{2}$.

STOCK-JOBING

Is the Buying into, or Selling out of the Public Funds.

RULE. If the Rate is above Par (that is, above 100), multiply the Stock by the Rate Excess, above 100, that Product divide by 100 or by 5, as in Interest. The Quotient added to the given Stock, will give the Sum to be paid for the Purchase or Selling.

If the Rate is under Par (that is, under £. 100), multiply the Stock by the Rate *per Cent.* that Product divide, as in Interest, either by 100 or by 5; and the Quotient will be the Sum of the Purchase or Selling.

EXAMPLES.

EXAMPLES.

I. Bought 700 *India-Stock*, at $135 \frac{3}{4}$ per Cent. How much Money must I pay? Facit £. 950 - 5.

$$5 \times 7 = 35$$

$$\text{So, } 700$$

$$5$$

$$3500$$

$$7$$

$$24500 = 35$$

$$350 = \frac{1}{2}$$

$$175 = \frac{1}{4}$$

$$250125 = 35 \frac{3}{4}$$

$$\begin{array}{r} \text{£. } 250 - 5 \text{ Quotient.} \\ 700 \text{ Stock.} \end{array}$$

950 - 5 To be Paid.

II. What is the Purchase of £. 254 - 17 *Bank Annuities*, at $97 \frac{1}{4}$ per Cent.? Facit £. 247 - 16 - 9 $\frac{3}{4}$.

$$8 \times 12 + 1 = 97,$$

$$254 - 17$$

$$8$$

$$2038 - 16$$

$$12$$

$$24465 - 12 = 96$$

$$254 - 17 = 1$$

$$63 - 14 - 3 = \frac{1}{4}$$

$$247184 - 3 - 3$$

$$\text{£. } 247 - 16 - 9 \frac{3}{4} \text{ I have added } \frac{1}{4} \text{ for the } 3\text{s.}$$

III. Sold 500 *three per Cent.* consolidated Annuities, at $75 \frac{3}{8}$. What am I to receive? Facit £. 378 - 2 - 6.

IV. What must I receive for £. 29 *three per Cent.* Annuities, When the Price is 74 per Cent.? Facit £. 21 - 9 - 2 $\frac{1}{4}$.

V. What must I pay for 135 Annuities ($3 \frac{1}{2}$), at $87 \frac{1}{2}$ per Cent.? Facit £. 118 - 2 - 6.

VI. What is the Purchase of £. 2750 - 17, *South-Sea old Annuities*, at $102 \frac{3}{8}$ per Cent.? Facit £. 2823 - 1 - 2 $\frac{1}{4}$.

BROKAGE,



BROKAGE

Is an Allowance that Merchants make to Brokers at a certain Rate *per Cent.* to Buy or Sell them Goods.

RULE. Divide the given Sum, as in Interest, by 100 or by 5, and in the Quotient whereof, take the Part or Parts of a £. the Rate is equal to.

EXAMPLES.

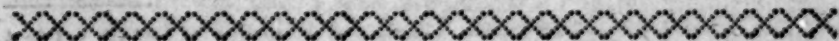
I. What is the Brokage of £. 146 - 17 - 6, at 6*s.* 9*d.* *per Cent.*?
Facit 9*s.* 10 $\frac{1}{2}$ *d.*

146 - 17 - 6	At 1 <i>per Cent.</i> =	£. 1 - 9 - 4 $\frac{1}{2}$
£. 1 - 9 - 4 - $\frac{1}{2}$		
5 <i>s.</i> = $\frac{1}{4}$		0 - 7 - 4
1 = $\frac{1}{5}$		0 - 1 - 5 $\frac{1}{2}$
6 <i>d.</i> = $\frac{1}{10}$		0 - 0 - 8 $\frac{1}{2}$
3 <i>d.</i> = $\frac{1}{20}$		0 - 0 - 4 $\frac{1}{4}$
6 <i>s.</i> 9 <i>d.</i> =		0 - 9 - 10 $\frac{1}{2}$

II. I gave Order to my Broker to buy Goods to the Amount of £. 350. If I allow him 5*s.* *per Cent.* What will his Brokage come to? Facit 17*s.* 6*d.*

III. What is the Brokage of £. 2346, at 7*s.* *per Cent.*? Facit £. 8 - 4 - 2 $\frac{1}{2}$.

IV. My Broker fold of my Goods to the Value of £. 64 - 17, What does the Brokage at 4*s.* *per Cent.* come to? Facit 2*s.* 7*d.*



REBATE or DISCOUNT

Is the Abating so much *per Cent.* on discharging in present Money a Debt agreed to be paid only at a Time to come.

RULE. Add the Interest of £. 100 for the given Time to £. 100; then say, as this Sum : £. 100 :: the Debt given : to the Present Money required (See CASE II. in Simple Interest). Then, to know what the Rebate amounts to, subtract the present Worth from the given Debt, and the Remainder will quote the Answer.

R

EXAMPLES.

EXAMPLES.

I. What is the present Worth and Discount of £. 240 for 4 Years, at 5 per Cent. per Annum? Facit £. 200 present Worth, and £. 40 Discount.

5 per Cent. $\times$ 4 Years $+ 100 = 120$; so, as 120 : 100 :: 240

Abbreviated, as 1. : 100 :: 2

2

200 present Worth.

Now, from 240 given Debt.
Subtract - - 200 present Worth.

Remains - 40 Rebate.

When the Time is more or less than 12 Months, you may state the Proportion thus: As 100 + the Rate : 100 :: the given Debt : the present Worth of a Year; which present Worth, when found, subtract from the given Debt, and you will have the Rebate of 1 Year (to be multiplied by the Number of Years that may be given) in which take Part or Parts accordingly. And thus, having found the whole Rebate, subtract it from the given Debt, to have the present Worth for the given Time.

II. What present Money will pay a Draught of £. 368 - 4, due 3 Months hence, allowing Rebate, at £. 5 per Cent. per Annum, and What will be the Sum of the Rebate? Facit £. 363 - 16 - 4, present Money, and £. 4 - 7 - 8 Rebate.

100 + 5 the Rate = 105; So, as 105 : 100 :: 368 - 4

Abbreviated, as 21 : 20 :: 368 - 4

or 1 : $1 - \frac{1}{21}$:: 368 - 4

Wherefore, from 368 - 4

Subtract $\frac{1}{21} = 17 - 10 - 8$

350 - 13 - 4

Note of Hand	£. 368 - 4	
Present Money for 1 Year	350 - 13 - 4	From £. 368 - 4
		Take 4 - 7 - 8
Rebate for 1 Year	17 - 10 - 8	
		Pr. W. 363 - 16 - 4
3 Months = $\frac{1}{4}$	4 - 7 - 8	

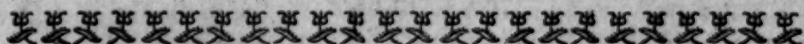
NOTE I. Had the Draught been drawn for 15 Months (that is, 1 Year and 3 Months); then the £. 4 - 7 - 8, Discount of 3 Months, should have been added to £. 17 - 10 - 8, Discount of 1 Year, and the Sum subtracted from the given Debt.

NOTE II. From the above Operation it appears, that when the Rate is at 5 per Cent. there is nothing else to do but to subtract $\frac{1}{21}$, from

from the given Debt, to have the Present Worth for 1 Year. And in the same Manner it is easy to find, that when the Rate is at 4 per Cent. there is nothing else to do but to subtract $\frac{1}{25}$.

III. What is the Discount of £. 275 - 10, for 7 Months, at 5 per Cent. per Annum? Facit £. 7 - 16 - 1 $\frac{3}{4}$.

IV. Sold Goods to the Value of £. 109 - 10, to be paid at 9 Months; What present Money will discharge the same, if I allow 6 per Cent. per Annum Discount, and what will be the Rebate? Facit £. 104 - 15 - 8 $\frac{1}{2}$ Present Money, £. 4 - 14 - 3 $\frac{1}{2}$ Rebate.



LOSS and GAIN.

CASE I. When the Prime-cost or Buying Price, and the Selling Price are known, to find the Rate per Cent. of Loss or Gain.

RULE. As the Prime Cost is to the Difference betwixt the Selling Price and the Prime Cost (which Difference is the Gain or Loss upon one of the Commodity) so is 100 to the Rate per Cent. of Gain or Loss required.

EXAMPLES.

I. Bought Cloth, at 14s. per Yard, and sold it for 18s. What did I gain per Cent.? Facit 28 $\frac{1}{4}$.

	<i>p.c. gain.</i>	
From 18s. Selling Price,	} So, as 14 : 4 :: 100 or 7 : 4 :: 50 or 1 : 4 :: 7 $\frac{1}{2}$	} 7 $\frac{1}{2}$ × 4 = 28 $\frac{1}{4}$.
Subtract 14s. Prime Cost,		
Remain 4s. Gain upon one,		

II. Suppose I had sold at 13s. per Yard, the Cloth I paid 14s. per Yard; What should I have lost per Cent.? Facit 7 $\frac{1}{4}$.

III. Some Goods that I had paid £. 324 for, I sold again for £. 397; What is the Gain per Cent.? Facit 22 $\frac{4}{5}$, or £. 22 - 10 - 7 $\frac{1}{4}$ +.

CASE II. When the Prime Cost, and an intended Rate per Cent. of Gain are given, to find the Price the Goods must be sold at,

RULE. As 100 : the Rate + 100 :: the Prime Cost : to the required Price.

EXAMPLES.

I. Bought Brandy, at 10s. per Gallon; What must I sell the Gallon to gain 10 per Cent.? Facit 11s.

As 10|0 : 11|0 :: 10s. abbreviated, as 1 : 11 :: 1s. : 11s. Answer.

II. Bought Wine, at 7s. 6d. per Gallon; What must I sell the Gallon again to gain 25 per Cent.? Facit 9s. 4 $\frac{1}{2}$ d.

R 2

III. Bought

III. Bought Cloth, at 14s. per Yard; How may I charge a Yard, to gain 28 $\frac{1}{2}$ per Cent. ? Facit 18s.

CASE III. If the Rate, proportional to another upon a new Price, is required.

RULE. Let the 1st Selling Price be the 1st Term, the Rate added as above to 100 be the 2d Term, and the new selling Price be the 3d Term.—From the Answer of this Rule of Three deduct 100, and the Remainder will be the new greater or lower Rate per Cent. required.

EXAMPLES.

I. Sold Tobacco, at 7d. per lb. upon which I had 10 per Cent. Markets rose to 8d. What did that Advance bring per Cent. ? Facit 25 $\frac{1}{2}$.

As 7d : 110 :: 8d. abbreviated, as 1 : 110 :: 1 + $\frac{1}{7}$.

So add $\frac{1}{7}$ to 110 - - - 110 $\frac{1}{7}$

125 $\frac{1}{7}$

Subtract - - - - - 100

Remains - - - - - 25 $\frac{1}{2}$ Answer.

II. Sold Cloth at 18s. upon which I had 15 per Cent. How much per Cent. had my Neighbour, who sold his Cloth, of the same Prime Cost, at 19s. 6d. Facit 24 $\frac{1}{2}$.

CASE IV. The Prime Cost being required, having the Selling Price and the Rate per Cent.

RULE. As the Rate per Cent. + 100 : 100 :: the Selling Price: the Prime Cost required.

EXAMPLES.

I. Sold Brandy 11s. a Gallon, and had 10 per Cent. What was the Prime Cost ? Facit 10s. a Gallon.

As 110 : 100 :: 11 : abbreviated, as, 1 : 10 :: 11.. : 10s. Answer.

II. Sold 25 Pieces of Cambrick, 10 Yards each, for £. 135, whereby I had 15 per Cent. What was the Prime Cost per Yard ? Facit 9s. 4 $\frac{1}{2}$ d. + $\frac{1}{3}$.



INSURANCE

Is a *Security* or *Assurance*, at a certain Rate *per Cent.* called *Premium*, to indemnify any Person of such Losses as are specified in a *Policy*. In Case of Loss, the Insurer can retain a certain Discount, generally at 2 *per Cent.* and then what he pays is called *Short Recovery*.

CASE I. To find the PREMIUM, *Principal* and *Rate* being given.

RULE. Multiply the *Principal* by the *Rate*, and divide either by 100, or by 5, as in *Commission* and *Simple Interest*.

EXAMPLES.

I. Insured the Value of £. 346, at 8 *per Cent.* What is the Premium? Facit £. 27 - 13 - 7.

$$\begin{array}{r} 346 \\ 8 \end{array}$$

$$\hline 27|68$$

$$\text{£. } 27 - 13 - 7 + \frac{1}{2}.$$

II. Insured at the Sun Fire-Office, the Value of £. 1654, at 3 *per Cent.* What is the Premium? Facit £. 2 - 9 - 7 $\frac{1}{2}$.

III. Shipped for Jamaica, Goods to the Value of £. 1549; What is the Premium at 9 *per Cent.*? Facit £. 139 - 8 - 2 $\frac{1}{4}$ $\frac{1}{2}$.

CASE II. The Rate of *Discount* and *Principal* being given, to find the *SHORT RECOVERY*.

RULE. Find the Discount as the Premium was found in the last CASE; then subtract in from the *Principal*, and the Remainder is the *Short Recovery*.

EXAMPLE.

Discount is allowed, at 2 *per Cent.* in recovering £. 346 insured; What is the *Short Recovery*? Facit £. 339 - 1 - 7.

$$346 \times 2 = 6|92$$

Then from £. 346

$$6 - 18 - 4 \frac{3}{4} \frac{1}{2}$$

$$\text{Subtract } - - 6 - 18 - 4 \frac{3}{4} \frac{1}{2}$$

$$\hline \text{Remain } - 339 - 1 - 7 \text{ } 0 \frac{1}{2}$$

CASE III. To find the Sum necessary to be insured, when the Adventurer wants to recover the whole Value at Risk.

RULE. Subtract from £. 100 the given Rate *per Cent.* Premium, and the Rate *per Cent.* Discount: Then say; as the Remainder; £. 100 :: the *Principal*; the Sum sought,

EXAMPLE.

The Premium being 8 *per Cent.* and Discount 2 *per Cent.* in Case of Loss; I want to cover £. 250; What Sum must I insure? Facit

£. 277 - 15 - 6 $\frac{1}{2}$.

£. 8 Premium

So, 9|0 : 10|0 :: 25|0

2 Discount

Abbrev. 1 : 1 + $\frac{1}{9}$:: 250

Therefore add $\frac{1}{9}$ - - 27 - 15 - 6 $\frac{1}{2}$ +

10 Subtracted

from 100 = 90

277 - 15 - 6 $\frac{1}{2}$

CASE IV. To find the Amount of Insurance of a Voyage Out and Home.

RULE. Deduct from 100 the Premium and Discount. Then say : as the Remainder : the Premium of 100 :: the Amount of the 1st Insurance together with the Outset : the Insurance Home ; which being added to the Insurance Outwards, makes the Total Insurance.

EXAMPLE.

The Premium of the £. 277 - 15 - 6 $\frac{1}{2}$ (in last CASE) at 8 *per Cent.* was - - - - - } £. 22 - 4 - 5 $\frac{1}{4}$ $\frac{3}{4}$

Add the Outset - - - 250 - 0 - 0

Deduct from £. 100

Premium - - 8

Discount - - 2

Remain - 90

272 - 4 - 5 $\frac{1}{4}$ $\frac{3}{4}$

As £. 90 : 8 :: £. 272 - 4 - 5 $\frac{1}{4}$ $\frac{3}{4}$

Abbreviated - -

45 : 4 ::

272 - 4 - 5 $\frac{1}{4}$ $\frac{3}{4}$

4

9 x 5 = 45, So

{ 9) 1088 - 17 - 9 $\frac{1}{4}$ $\frac{1}{3}$
{ 5) 120 - 19 - 9 +

Insurance Home - - - - -

24 - 3 - 11 $\frac{3}{4}$ +

Insurance Out - - - - -

22 - 4 - 5 $\frac{1}{4}$

Total Insurance - - - - -

46 - 8 - 5

To find what will cover this Sum Homewards, it will be as in last CASE, thus: As £. 9|0 : 10|0 :: £. 272 - 4 - 5 $\frac{1}{4}$ $\frac{1}{3}$

10

9) 2722 - 4 - 5 $\frac{1}{4}$ $\frac{1}{3}$

To be insured Home - - - - -

£. 302 - 9 - 4 $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{3}$

It would have been sufficient to add to £. 272 - 4 - 5 - $\frac{1}{4}$ the 9th Part.

EQUATION

EQUATION of PAYMENTS. 3127

EQUATION of PAYMENTS

Is when a certain Sum is to be paid at different Times, and the Debtor and Creditor agree upon an equated Time to pay the Whole at once.

RULE. Multiply each Sum by the Time the Payment becomes due, and divide the Total of all the Products, by the Whole Debt. The Quotient, will be the mean Time to pay the Whole without Prejudice to either.

EXAMPLES.

I. Suppose I owe A. £. 600, whereof £. 240 are to be paid at 4 Months, £. 200 at 5 Months, £. 90 at 6 Months, and £. 70 at 10 Months: but we agree upon an equated Time to pay the Whole at once: What is the just Time of Payment? Facit $5\frac{1}{3}$ Months.

$$\begin{array}{r}
 \text{£. 240} \times 4 = 960 \\
 200 \times 5 = 1000 \\
 90 \times 6 = 540 \\
 70 \times 10 = 700 \\
 \hline
 6100 \qquad 32100 \\
 5 + \frac{1}{3} \text{ or } \frac{16}{3} = 10 \text{ Days.}
 \end{array}$$

II. A. owes B. £. 120, whereof $\frac{1}{2}$ is to be paid at 3 Months, $\frac{1}{4}$ at 6 Months, and the rest at 9 Months: What would be the equated Time of the Payments? Facit 5 Months 7 Days.

III. H. is indebted to L. a certain Sum, which is to be Paid at 6 different Payments, viz. $\frac{1}{8}$ at 2 Months, $\frac{1}{8}$ at 3 Months, $\frac{1}{8}$ at 4 Months, $\frac{1}{8}$ at 5 Months, $\frac{1}{8}$ at 6 Months, and the Rest at 7 Months: but they agree that the Whole should be paid at one equated Time, What is that Time? Facit $4\frac{1}{4}$ Months.

The lower Fraction being eighth Parts, the $\frac{1}{4}$ must be reduced in Eighths, and will equal $\frac{2}{8}$. So,

$$\begin{array}{r}
 \frac{1}{4} \text{ or } \frac{2}{8} \times 2m. = \\
 \frac{1}{8} \times 3 = \\
 \frac{1}{8} \times 4 = \\
 \frac{1}{8} \text{ or } \frac{1}{8} \times 5 = 1 \\
 \frac{1}{8} \times 6 = \\
 \hline
 \frac{2}{8} \times 7 = 2 \\
 \hline
 \frac{26}{8} = 3 + \frac{2}{8} \\
 + 1 = 4 \frac{2}{8}
 \end{array}$$

The Rest to make a Whole must be } $\frac{2}{8}$ or Whole Debt = $4\frac{2}{8}$ or $4\frac{1}{4}$.

BARTER

BARTER

Is the Exchanging of one Commodity for another, and teaches so to proportion the Goods to be exchanged that neither Party may sustain Loss.

RULE I. Multiply the assigned Quantity by its Price, and divide the Product by the Price of the Quantity required.

II. When one has Goods at a certain Price *Ready Money*: but in *Bartering* advances it to something more: then, to find what the other ought to *rate* his Goods at, in Proportion to that Advance, say: as, the *Ready Money* Price of the Goods of the first: his *Bartering* Price :: the *Ready Money* selling Price of the other: the *proportional Rate* he is to fix his Goods at.

III. When a proportional Quantity is required to be given in Barter for another; then, multiply the given Quantity by its given Price in Barter, the Product divide by the Price in Barter of the required Quantity, and the Quotient will be the Answer.

IV. When an equal Quantity, at different Prices, of a Commodity is required for another given Quantity; multiply this given Quantity by its given Price, and divide the Product by the different Prices added together.

EXAMPLES.

I. How many *lbs.* common Bohea Tea at 2s. 3d. a *lb.* may I have in Barter for 80*lbs.* of best Bohea Tea, at 3s. 6d. a *lb.*?
Facit 124*lbs.* 7 $\frac{1}{2}$ oz.

As the Price of the common Bohea, to be the Divisor, is Applicate; so, you must reduce both Prices to the lowest mentioned Denomination, viz. three Pence; then the Divisor 2s. 3d. Price of the common Bohea, will be 9 three Pence, and the Multiplier 3s. 6d. price of the best, will be 14 three Pence.

Multiply the given Quantity 80*lbs.* best Bohea Tea.
by its Price . . . 14 Three Pence.

The Product divide by 9 three Pence) 1120

Price of the Quantity sought. 124*lbs.* 7oz. + $\frac{1}{2}$.

II. B has Wine, at £. 13 - 10 per Hogshead, *Ready Money*, which he wants to exchange for Brandy. C has Brandy, which he sells £. 7 - 4 per Hogshead, *Ready Money*; but in Barter will have £. 7 - 18. What ought B rate his Wine at in Barter? Facit £. 14 - 16 - 3.

£. 7 - 4

TARE and TRET T.

129

£. 7 - 4 Ready Money : £. 7 - 18 in Barter :: £. 13 - 10 Ready Money.
Or, 144s. : 158s. :: 270

11060

316

144) 42660 (29|6s. 3d. or £. 14 - 16 - 3

1386

900

36

12

432

00

III. Suppose I had 20cwt. of Prunes at 4d. per lb. Ready Money : but, in Barter, would have 5d. per lb. And A had Hops at 32s. per cwt. Ready Money : what ought A to rate his Hops at in Barter ; and, what Quantity of Hops must be given in Barter for my 20 cwt. ? Facit 40s. Rate ; and $23\frac{1}{3}$ cwt. Quantity.

1st, by RULE II. As 4d. Ready Money : 5d. in Barter :: 32s. Ready Money : 40s. the Answer and Rate of the Hops in Barter.

2dly, by RULE III. 20cwt. or 2240lbs. $\times$ 5d. their given Price in Barter = 11200d. $\div$ 40s. or 480d. the Price in Barter of the Hops = $23\frac{1}{3}$ cwt.

IV. How many Bottles of best Burgundy at 4s. common ditto at 1s. and Brandy at 2s. of each an equal Number, may I have in Barter for 420 Yards of Cambrick at 6s. per Yard ? Facit 360 Bottles of each.

420

6

Or, from 420

Subtract $\frac{1}{7}$ 60

which is the same as to multiply by 6, —

4+1+2=7) 2520

360

and divide by 7.

360

TARE and TRET T.

TARE, is an Allowance for the Weight of what Goods are packed in, at a certain Rate per Cent. or at so many lbs. in the Gross Weight, or per Box, Bag, Barrel, &c.

TRET, is an Allowance of 4lbs. per 104lbs. for Goods that are liable to Loss or Waste.

S

N. B.

N. B. There is in *London* another Allowance of *2lbs. per 3cwt.* on some sort of Goods, and that Allowance is called *CLOFF*.

GROSS WEIGHT, is the Whole Weight of any sort of Goods, and the *Box, Bag, Barrel, &c.* which contains it.

SUTTLE, is the Remainder of any Allowance deducted from the Gross.

NEAT, is the pure Weight, when all Allowances are deducted.

RULE I. TO FIND THE NEAT, when TARE is to be deducted. If the *Tare* is at so many *lbs. per Box, Bag, Barrel, &c.* multiply the Number of *Boxes, Bags, Barrels, &c.* by the *Allowance*; and subtract the Product from the given Weight. If the *Tare* is at so much *per Cent.* then say: as *112lbs. : 112lbs.*—the *given Tare :: the given Gross Weight : the Answer.*

N. B. In this second Case, it may more readily be found by taking (according to the following Table) in the given Gross Weight, the Aliquot Parts of 112 and subtracting their Amount from it.

$$\begin{array}{l} 16\text{ lbs.} = \frac{1}{7} \mid 8\text{ lbs.} = \frac{1}{2} \text{ of } \frac{1}{7} \mid 4\text{ lbs.} = \frac{1}{4} \text{ of } \frac{1}{7} \mid \&c. \\ 14 = \frac{1}{8} \mid 7 = \frac{1}{2} \text{ of } \frac{1}{8} \mid 3\frac{1}{2} = \frac{1}{4} \text{ of } \frac{1}{8} \end{array}$$

II. TO FIND THE NEAT, when TARE and TRET are both to be deducted. Work for *Tare* as above; then from its *Suttle*, subtract $\frac{1}{16}$, or the Quotient of $2 \div 13$ (which is the same as to multiply by 4 and divide by 104); the Remainder will be the Neat.

EXAMPLES.

I. What is the Neat Weight of 6 Boxes of Tea, weighing Gross 720lbs. Tare 16lbs. per Box? Facit 624lbs.

6 Boxes $\times$ 16lbs. Tare = 96; So, $720 - 96 = 624\text{lbs.}$ Neat.

II. What is the Neat Weight of 384cwt. 3qrs. 24lbs. Tare 17 per cwt.? Facit 326cwt. 2qrs. 3lbs.

As 112lbs. in a cwt. : 112—the Tare 17, or 95 :: 43116lbs. (for the 384cwt. 3qrs. 24lbs) : the Neat required.

Abbreviated, as 28lbs. : 95 :: 10779lbs.

$$\begin{array}{r} 95 \\ \hline 53895 \\ 97011 \end{array}$$

$$28 = 7 \times 4, \text{ So, } \dots 7) 1024005$$

$$4) 146286 + \frac{3}{4}$$

$$\text{Neat Weight in lbs. } \dots 36571 + 2 \times 7 + 3 = \frac{17}{8}$$

To have cwt. divide by 112

Or, as $4 \times 7 \times 4 = 112$, So, . . .

$$4) 36571$$

$$7) 9142 - 3\text{qrs.}$$

$$4) 1306 - 0 - 12\text{lbs.}$$

Neat Weight in cwt. qrs. and lbs.

$$326 - 2 - 3$$

Or

TARE and TRET T. 131

Or thus, by *Aliquot Parts and Subtraction.*

	cwts.	grs.	lbs.	
	384	- 3	- 24	at 17 per cwt.
14lbs. = $\frac{1}{8}$	48	- 0	- 13 $\frac{4}{8}$	or $\frac{1}{2}$
2 = $\frac{1}{4}$ of the $\frac{1}{8}$ for 14lbs.	6	- 3	- 13	$\frac{1}{2} + \frac{6}{7}$
1 = $\frac{1}{2}$ of 2lbs.	3	- 1	- 20	$\frac{1}{2} + \frac{1}{14}$
17 =	58	- 1	- 20	+ $\frac{2}{2} \frac{1}{14}$

Now, from 384 - 3 - 24
Deduct Tare 58 - 1 - 20 $\frac{2}{2} \frac{1}{14}$

Remain Neat 326 - 2 - 3 $\frac{1}{2} \frac{3}{4} = \frac{17}{8}$

III. In 12 Butts of Currants, each 7cwts. 1qr. 13lbs. Gross, Tare 17lbs. per cwt. Trett 4lbs. per 104, How many lbs. Neat? Facit 8084.

7	9912	2) 8407 $\frac{1}{2}$
7		13) 4203 $\frac{3}{4}$
7	14lbs. = $\frac{1}{8}$ 1239	Trett 323 $\frac{1}{4} + \frac{6}{13}$
7	2 = $\frac{1}{4}$ of 14 177	
42 = 1qr. 14lbs.	1 = $\frac{1}{2}$ of 2 88 $\frac{1}{2}$	
826	Suttle 8407 $\frac{1}{2}$	
12 Butts.	Deduct Trett 323 $\frac{1}{4} \frac{6}{13}$	
9912	Neat Weight 8084 $\frac{2}{2} \frac{7}{13}$	

IV. What is the Neat Weight of 3 Hhds. of Tobacco, weighing 15cwts. 3grs. 20lbs. Gross, Tare 7lbs. per cwt. Trett 4lbs. per 104, Cloff 2lbs. per 3cwts.? Facit 14cwts. 1qr. 2 $\frac{3}{4}$ lbs.

7 = $\frac{1}{2}$ } 8) 15 - 3 - 20	15 - 3 - 20	
of $\frac{1}{8}$, So, } 2) 1 - 3 - 27	3 - 27 $\frac{1}{2}$	Tare.
Tare 0 - 3 - 27 $\frac{1}{2}$		
2) 14 - 3 - 20 $\frac{1}{2}$	14 - 3 - 20 $\frac{1}{2}$	Suttle.
13) 7 - 1 - 24 $\frac{1}{4}$	2 - 8 $\frac{1}{4}$	Trett.
Trett . . 0 - 2 - 8 $\frac{1}{4}$ +	14 - 1 - 12 $\frac{1}{4}$	Suttle.
	0 - 0 - 9 $\frac{1}{2}$	Cloff.

For Cloff, sub. $\frac{1}{3}$) 14cwts.
4 $\frac{2}{3}$ + 14 - 1 - 2 $\frac{3}{4}$ Neat.
Cloff 9 $\frac{1}{2}$ lbs.

V. What is the Neat Weight of 10 Hhds. of Tobacco, weighing Gross 52cwts. Tare 70lbs. per Hhd.? Facit 45cwts. 3grs.

VI. In one Butt of Currants, weighing 12cwt. 2qrs. 24lbs. Gross, Tare 14lbs. per Cent. Trett 4lbs. per 104lbs. How many Pounds Neat? Facit 1199.

VII. In 57 Butts weighing Gross 732cwt. 1qr. 21lbs. Tare 10lbs. per Butt, and Trett 4lbs. per 104; How many cwt. Neat? Facit 694cwt. 3qrs. 24 $\frac{1}{2}$ lbs.

VIII. In 7 Hhds. of Sugar, each weighing Gross 5cwt. 2qrs. 7lbs. Tare 8lbs. per Cent. Trett 4lbs. per 104, Cloff 2lbs. per 3cwt. How much Neat Weight? Facit 34cwt. 2qrs. 8lbs.



E X C H A N G E

Is the Commutation of the Money of one Country for that of another, according to a certain Value or Rate agreed on amongst Merchants.

The Par of Exchange is always fixed, it being the Intrinsic Value of Foreign Money compared with Sterling: but the Course of Exchange rises or falls upon various Occasions.

RULE I. To exchange Sterling Money with Foreign Money, say: as, the given Sterling Course of Exchange: the given Foreign Denomination or Piece of Money :: the given Sterling Sum : the required Foreign Sum.

II. To exchange Foreign Money with Sterling Money; as, the given Foreign Denomination or Piece of Money : the given Sterling Course of Exchange :: the given Foreign Sum : the required Sterling Sum.

But when the Exchange is at a Rate per Cent. called *Agio*, as Sterling Money with Irish, Bank Money with Current, &c. work, in the above two Cases, as follows:

I. As £. 100 Sterling or Bank Money : £. 100 Irish or Current Money + the *Agio* or Rate per Cent. :: the given Sterling or Bank Sum : the Irish or Current Sum required.—And for the Reverse:

II. As £. 100 Irish or Current Money + the *Agio* or Rate per Cent. : £. 100 Sterling or Bank Money :: the given Irish or Current Sum : the Sterling or Bank Sum required.

EXAMPLES.

FRANCE.

They keep their Accounts in France, in *Livres*, *Sols* and *Déniers*: but they exchange by the *Ecu* or *Crown*; and 31 $\frac{1}{2}$ d. or 2s. 7 $\frac{1}{2}$ d. Sterling, being equal to 3 *Livres* or the *Ecu*; so, 31 $\frac{1}{2}$ d. is the Par with France.

N. B.

EXCHANGE.

133

N. B. 12 *Déniers* = 1 *Sol*; 20 *Sols* = 1 *Livre*; 3 *Livres* = 1 *Ecu* or *Crown*.

I. London draws on Paris £. 546 - 15 - 3, How many *Livres* will clear the Draught at Paris, the Exchange being at 3 *d.* per *Ecu* or *Crown*? Facit 12699 *Livres*.

3 *d.* Sterling : 3 *French Livres* :: £. 546 - 15 - 3. Or, 131223 *d.* Ster.

$$\begin{array}{r} 3 \\ 31) 393669 \text{ (12699)} \\ \underline{83} \\ 216 \\ \underline{306} \\ 279 \\ \underline{00} \end{array}$$

II. Paris draws on London 9600 *Livres*, How many Pounds Sterling will clear at London the Draught of Paris, the Exchange being at 30 *d.* per *Ecu* of 3 *Livres*? Facit £. 400 Sterling.

As 3 *Livres* : 30 *d.* Sterling :: 9600 *Livres*.

Abbreviated, 1 : 10 :: 9600

$$\begin{array}{r} 10 \\ 12) 96000 \\ \underline{210} 8000 \\ 400 \end{array}$$

III. London draws on Paris for £. 566 - 13 - 4, How many *Livres*, &c. will clear the Draught at Paris, the Exchange being at 3 *d.* per *Ecu*? Facit 13161 - 5 - 9 $\frac{2}{3}$.

IV. The Exchange being at 32 *d.* per *Ecu*, How many Pounds, &c. Sterling will clear at London a Draught of Paris of £. 12302 - 3 - 1 $\frac{1}{2}$? Facit £. 546 - 15 - 3.

☞ When the Exchange is at Par; then, to bring *Sterling Money* into *French*, reduce Pounds into Shillings and add the 7th Part; and to bring *French Money* into Shillings, subtract the 8th Part from *French Livres*. See in *Whole Numbers* the 2 last Examples in the Rule of three by *Contraction*.

SPAIN.

The Bankers at *Madrid*, *Cadix*, *Seville*, &c. keep their Accounts in *Piaftres*, *Rials* and *Mervadies*, reckoning 34 *Mervadies* to a *Rial*, and 8 *Rials* to a *Piaftre* or Piece of Eight, the Par of which is 43 *d.* or, 3s. 7 *d.* Sterling.

V. London remits to *Cadix* £. 576 - 12 - 2 $\frac{3}{4}$ Sterling, Exchange at 37 $\frac{1}{4}$ *d.* per *Piaftre*, How much will be received for this Remittance at *Cadix*? Facit 3653 *Piaft.* 6 *Ri.* 6 $\frac{1}{2}$ *Mer.*

As

As $37 \frac{1}{8} d. : 1 \text{ Piaft.} :: \text{£. } 576 - 12 - 2 \frac{3}{4}.$

8

20

303

11532

12

138386

8

Here, because the Divisor's Denomination is 8ths, I must multiply by 8, taking in 6 for the $\frac{3}{4}$.

303) 1107094 (3653 - 6 - 6

1980

1629

1144

The Remaining Piaftres

235

Multiply by . . . 8 Rials.

1880

The Remaining Rials

62

Multiply by . . . 34 Mervadies.

248

186

2008

Remain . . . 190 above $\frac{1}{2}$.

VI. Cadix remits to London 3653 Piaft. 6 Ri. 7 Mer. at $37 \frac{1}{8} d.$ Exchange per Piaftre, What will the Remittance amount to in London? Facit $\text{£. } 576 - 12 - 2 \frac{3}{4}.$

As 1 Piaft. : $37 \frac{1}{8} d. :: 3653 \text{ Piaft. } 6 \text{ Ri. } 7 \text{ Mer.}$

8

8

8

29230

34

34

272

116927

87690

993827

37

6956789

2981481

496913

248456

124228

$37641197 \frac{1}{2} \div 272 = 138386 \frac{1}{2} d.$

Or, $\text{£. } 576 - 12 - 2 \frac{3}{4}.$

VII. How

VII. How many Pieces of Eight at 32d. each, will answer a Bill of £.594 - 6 Sterling? Facit 4457 + 2 Rials.

VIII. If I am to remit 4457 Piaſtres, 2 Rials at Seville, Exchange at 32d. per Piaſtre, How much Sterling is the Sum? Facit £.594 - 6.

GENOA and LEGHORN.

The Bankers at Genoa and Leghorn, keep their Accounts in Piaſtres or Pezzoes, which are divided into Soldi and Denari, as the British Pound.—The Par of a Piaſtre or Pezzoe is 54d. Sterling.

IX. London is indebted to Genoa in £.1710 - 16 - 4 Sterling, How many Pezzoes will the Sum come to, Exchange at 47 ½d. ? Facit 8644 Pez. 2 Sold. 6 Den.

As 47 ½d. : 1 Pez. :: £.1710 - 16 - 4.

Reduced 95 Half Pence : 1 :: 821192 Half Pence.

So, $821192 \div 95 = 8644 - 2 - 6$.

X. Genoa is indebted to London in 8644 Pez. 2s. 6d. How much Sterling will the Sum come to, Exchange at 47 ½d. Sterling per Pezzoe? Facit £.1710 - 16 - 4.

As 1 Pez. : 47 ½d. Sterling :: 8644 Pez. 2s. 6d.

20	20
20	172882
12	12

240 Denari.

2074590 Denari.

So, $2074590 \times 47 \frac{1}{2} \text{d. Sterling} = 98543025 \text{ Denari} \div 240 \text{ Denari} = 410595 \frac{5}{8} \text{d. Sterling} + \frac{5}{8} \text{ or } \text{£.1710 - 16 - } 3 \frac{3}{8} + \frac{5}{8} \text{ nearly another Farthing.}$

The above Operation would have more readily been resolved by Practice, thus:

40d. = of a £. $\frac{1}{5}$) 8644 Pez. 2s. 6d.

	1440 -	13 -	9
5 = $\frac{1}{8}$ of 40d.	180 -	1 -	8 $\frac{5}{8}$
2 ½ = $\frac{1}{2}$ of 5d.	90 -	0 -	10 $\frac{2}{8} + \frac{1}{8}$

£.1710 - 16 - 3 + $\frac{7}{8} + \frac{1}{8}$ nearly 1d.

XI. London draws on Leghorn for £.465 - 19 - 6 Sterling, What must be paid at Leghorn, Exchange at 46d. per Piaſtre? Facit 2431 Piaſ. 3s. 5 $\frac{3}{4}$ d.

XII. Leghorn draws on London for 2431 Piaſ. 3s. 5 $\frac{3}{4}$ d. How much Sterling will pay the Bill at London, Exchange at 46d. per Piaſtre? Facit £.465 - 19 - 6.

VENICE.

Money of Exchange is that of Ducats in Bank, which is imaginary, 100 whereof are equal to 120 Ducats current Money; so, that the Difference betwixt Bank and current Mohey, is an *Agio* of 20 per Cent.—The Par of a Ducat Banco is 4s. 4d. Sterling.—12d. Banco=1s. Banco; and, 20s. Banco=1 Ducat Banco.

XIII. London draws on Venice for £.541 - 18 Sterling, How much must be paid at Venice, Exchange at $45\frac{5}{8}$ per Ducat Banco? Facit 2850duc. 10s. 10d.

$$\text{As } 45\frac{5}{8}d. : 1 \text{ Ducat Banco} :: \text{£.541} - 18$$

8	20
365	10838
	12
	130056
	8
	1040448

$$\text{So, } 1040448 \div 365 = \text{£.2850} - 10 - 10$$

XIV. Venice draws on London for 2850 Ducats 10s. 10d. Banco. Exchange at $45\frac{5}{8}$ per Ducat, How much Sterling will pay the Draught? Facit £.541 - 18.

$$40d. = \frac{5}{8} \quad 2850duc. 10s. 10d. Banco.$$

$\frac{5}{8} = \frac{5}{8}$ of 40	475 - 1 - 9 $\frac{5}{8}$	} These Fractions = nearly 2:
$\frac{5}{8} = \frac{5}{8}$ of 5d.	59 - 7 - 8 $\frac{5}{8}$ +	
	7 - 8 - 5 $\frac{5}{8}$ +	

$$541 - 18 - 0$$

XV. Venice is indebted to London in 4789 Ducats 19s. 3d. current Money; How much Sterling may London draw for, *Agio* at 20 per Cent. when the Exchange is at 4s. 1d. per Ducat Banco? Facit £.814 - 19 - 2.

$$\text{1st, To find the Bank Money, } 12|0 : 10|0 :: 4789 - 19 - 3$$

$$\text{Abbreviated, } 1 : 1 - \frac{1}{5} :: 4789 - 19 - 3$$

$$\text{So, Subtract } \frac{1}{5} \quad 798 - 6 - 6 \frac{1}{5}$$

$$3991 - 12 - 8 \frac{1}{5}$$

$$\text{2dly, } 1 \text{ Ducat Banco} : 49d. :: 3991 - 12 - 8 \frac{1}{5}$$

$$\text{Reduced } 480d. B. \quad 49d. :: 1915985d. Banco.$$

$$\text{And, therefore } 1915985 \times 49 = 93883265 \div 480 = 195590d. \text{ Sterling.}$$

$$\text{Or, } \text{£.814} - 19 - 2.$$

PORTUGAL.

Accounts are kept in *Milreas* and *Reas*, reckoning 1000 of the latter to one of the former.—The Par of a Milrea is 5s. 7 $\frac{1}{2}$ d. Sterling.

XVI. London

XVI. London remits to Oporto £. 578 - 19 - 6, Exchange at 5s. 3d. per Milrea; What will be received at Oporto? Facit 2205 Milreas 619 Reas.

63d : 1 Mil. :: £. 578 - 19 - 6, or 138954d. : 2205 Mil. 619 Reas.

XVII. Oporto remits to London 2205 Milreas 619 Reas, Exchange at 5s. 3d. per Milrea; How much Sterling will this be reckoned at in London? Facit £. 578 - 19 - 6.

1 Mil. or 1000 R. : 63d :: 2205619 R. : 138954d. or £. 578 - 19 - 6.

HOLLAND.

Accounts, there, are by some kept in Pounds, Shillings, and Pence, as in England: but generally in Guilders or Florins, Stivers and Pennings; reckoning 16 Pennings (= 2 Groats) to a Stiver, and 20 Stivers to a Guilder or Florin. They reckon also 12 Groats, or 6 Stivers, to a Schelling, and 20 Schellings, or 6 Guilders, to a Pound Flemish.—Bank Payment is reckoned from 3 to 6 per Cent. better than a Payment in Cash.

XVIII. Remitted from London to Amsterdam, a Bill of £. 574 - 10 Sterling; How many Pounds Flemish is the Sum, Exchange at 33s. 6d. Flemish per Pound Sterling? Facit £. 1263 - 15 - 9 Flemish.

As £. 1 Sterl. : 33s. 6d. Flem. :: £. 574 - 10 Sterl. : £. 1263 - 15 - 9 Fl.

XIX. How much Sterling should be received in London for £. 1263 - 15 - 9 Flem. Exchange at 33s. 6d. Flem. per Pound Sterling? Facit £. 574 - 10.

As 33s. 6d. Flem. : £. 1 Sterl. :: £. 1263 - 15 - 9 Flem. : £. 574 - 10 St.

XX. If I pay in London £. 852 - 12 - 6 Sterling; How many Guilders, Stivers, and Pennings may I draw for at Amsterdam, Exchange at 34 Schel. $4\frac{1}{2}$ Groats Flemish per Pound Sterling? Facit 8792 Guild. 13 Stiv. $14\frac{1}{2}$ Pennings.

As £. 1 St. : 34 Schel. $4\frac{1}{2}$ gr. :: £. 852 - 12 - 6 St.

$$\begin{array}{r} 20 \quad 12 \\ \hline 20 \quad 412 \\ 12 \quad 8 + 4 \text{ for the } \frac{1}{2} \end{array}$$

24|0d. : 330|0 Pennings :: 20463|0 d.

13 $\frac{3}{4}$ Pennings.

abbreviated 1 : 13 $\frac{3}{4}$

2660190

$\frac{1}{2}$ = - - 102315

$\frac{1}{4}$ = - - 51157 $\frac{1}{2}$ Pennings.

16 Pen. = 8 X 2 - - -

8) 2813662 $\frac{1}{2}$ Pennings.

1 2) 351707 + $\frac{6}{8}$

2|0) 17585|3 Stivers + 14 $\frac{1}{2}$ Pen.

8792 Guild. 13 St. 14 $\frac{1}{2}$ Pen.

T

XXI. What

XXI. What must I draw for at London, if I pay at Amsterdam 8792 Guild. 13 Stiv. $14\frac{1}{2}$ Pennings, Exchange at 34 Schel. $4\frac{1}{2}$ Groats per Pound Sterling? Facit £. 852 - 12 - 6 Sterl.

IRELAND.

Accounts are kept in Pounds, Shillings, and Pence, Irish, divided as in Britain, which exchanges with Ireland upon the £. 100 Sterling, the Par of which is £. 108 - 6 - 8.

XXII. London remits to Ireland £. 357 - 18 Sterling; for how much Irish ought London to be credited for this Remittance, Exchange being at $10\frac{2}{3}$ per Cent.? Facit £. 395 - 18 - $6\frac{1}{2}$ Irish.

As £. 100 Sterl. : $110\frac{2}{3}$ Irish :: £. 357 - 18 Sterl. : £. 395 - 18 - $6\frac{1}{2}$ Ir.

XXIII. Ireland draws on London for £. 395 - 18 - $6\frac{1}{2}$ Irish, Exchange at $10\frac{2}{3}$ per Cent. How much Sterling will Ireland be debited with at London? £. 357 - 18.

As £. $110\frac{2}{3}$ Irish : £. 100 Sterl. :: £. 395 - 18 - $6\frac{1}{2}$ Irish : £. 357 - 18 St.



F E L L O W S H I P

Teaches, by as many Rules of Three as there are Partners in any Business, to find each Person's particular Share of the Gain or Loss, in Proportion to his Principal in the joint Stock.

RULE. I. *The Principal of each Partner being for an equal Term of Time*; add the Principals together: then say; as the Total or Whole Stock is to the Whole Gain or Loss, so each Partner's Principal is to his Share of Gain or Loss.

II. *The Principal of each Partner being for an unequal Term of Time*; multiply each Partner's Principal by its Time, to have new Principals; add the Products together, then say; as the Total: the Whole Gain or Loss :: each Partner's new Principal: his Share of Gain or Loss.

FOR PROOF. Add each Partner's Gain or Loss found, and the Total must come the same as the Whole given Sum of Gain or Loss.

EXAMPLES.

I. Two Merchants, A and B, trade together. A put into Stock £. 345, and B £. 400. They gained £. 154; What is each Partner's Share thereof? Facit, A's, £. 71 - 6 - $3\frac{1}{2}$, B's, £. 82 - 13 - $8\frac{1}{4}$.

345 A's Stock.

400 B's Stock.

745 Whole Stock.

FELLOWSHIP.

139

745 Whole St. : 154 Gain :: 345 A's St. 745 : 154 :: 400 B's St.

345	400
770	745)61600(82 - 13 - 8 $\frac{1}{4}$
616	2000
462	510
	20
745)53130(71 - 6 - 3 $\frac{1}{2}$	
980	10200
235	2750
20	515
	12
4700	6180
230	220
12	4
2760	880
525	135
4	
2100	
610	

Proof. . . { A's Gain . . . £. 71 - 6 - 3 $\frac{1}{2}$ + $\frac{610}{745}$
 { B's Ditto . . . 82 - 13 - 8 $\frac{1}{4}$ + $\frac{135}{745}$

Whole Gain . £. 154 - 0 - 0

II. C and D trade together. C put £. 40 for 3 Months, and D £. 75 for 4 Months. They lost £. 70; What is each Partner's Share of the Loss? Facit C's £. 20, D's £. 50.

40 C's Stock $\times$ 3 Months = 120
 75 D's Stock $\times$ 4 Months = 300

420 Whole supposed Stock.

42|0 : 7|0 :: 120

42|0 : 7|0 :: 300

Abbreviated 1 : 1 :: 20 Abbreviated - - 1 : 1 :: 50
 III. Three Merchants traded together. A put in Stock £. 4000; B put £. 5000, and C put £. 3000. At the End of 4 Years they settled together, and found they had gained £. 15000: What was each Man's Share thereof? Facit A's £. 5000, B's £. 6250, C's £. 3750.

IV. Three Merchants traded together. A put in £. 150 for 16 Months; B £. 240 for 14 Months, and C £. 145 for 9 Months. They gained £. 160: How must the Gain be divided? Facit, to A £. 54 - 7 - 0 $\frac{1}{2}$, to B £. 76 - 1 - 10 $\frac{1}{4}$, to C £. 29 - 11 - 0 $\frac{3}{4}$.

V. A compounds his Debts with his Creditors, at 5s. 6d. per £. Sterling. He owes to B £. 300, to C £. 454, to D £. 548. What will each receive? Facit B £. 82 - 5, C £. 124 - 17, D £. 150 - 14.

T 2

Such

Such a Question is stated thus, and may readily be resolved by Practice.

$$£. 1 : 5s. 6d. :: £. 300 B : £. 82 - 5$$

$$£. 1 : 5s. 6d. :: £. 454 C :: £. 124 - 17$$

$$£. 1 : 5s. 6d. :: £. 548 D :: £. 150 - 14.$$

VI. Three Merchants joined in Trade. A put £. 2000 for 2 Years; B £. 3000 for 3 Years, and C £. 4250 for 4 Years. They gained £. 10000. What is the Share of each, in Proportion to his Principal and Time? Facit A's £. 1333 - 6 - 8; B's £. 3000, and C's £. 5666 - 13 - 4.

VII. Four Merchants B, C, D, and E, made a Stock; B put in £. 227; C £. 349; D £. 115, and E £. 439; in Trading they gained £. 428; I demand each Merchant's Share of the Gain? Facit B's £. 85 - 19 - 6 $\frac{3}{4}$ + 690. C's £. 132 - 3 - 9 + 120. D's £. 43 - 11 - 1 $\frac{3}{4}$ + 250. E's £. 166 - 5 - 6 $\frac{1}{4}$ + 70.

VIII. A Merchant is indebted to B £. 275 - 14; to C £. 304 - 7; to D £. 152, and to E £. 104 - 6.—But upon his Decease, his Estate is found to be worth but £. 675 - 15. How must it be divided amongst his Creditors? Facit B £. 222 - 15 - 2 + 6584; C £. 245 - 18 - 1 $\frac{1}{2}$ + 15750; D £. 122 - 16 - 2 $\frac{3}{4}$ + 12227, and E £. 84 - 5 - 5 + 15620.

Such Question as this is resolved thus: as, the Total of the Debts: the Estate :: each Creditor's Sum: What he is to receive?

IX. Four Persons traded together in a joint Stock, of which A had $\frac{1}{3}$, B $\frac{1}{4}$, C $\frac{1}{5}$, and D $\frac{1}{6}$, and they gained £. 100; What is each Man's Share of the said Gain? Facit A £. 35 - 1 - 9 $\frac{3}{4}$ + $\frac{13}{57}$, B £. 26 - 6 - 3 $\frac{3}{4}$ + $\frac{3}{57}$, C £. 21 - 1 - 0 $\frac{1}{2}$ + $\frac{30}{57}$, D £. 17 - 10 - 10 $\frac{1}{2}$ + $\frac{6}{57}$.

In such Questions as this, it is necessary to seek for a Number wherein may be taken, without any Remainder, all the given fractional Parts (here the Number 60 may properly be chosen, because it contains $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, and $\frac{1}{6}$, without any Remainder); then you must add all the Quotients together, and say; as, the Total; the Gain or Loss :: each Man's supposed Stock from the supposed Number: his Share of Gain or Loss.

X. D, E, and F, joined Stocks in Trade; the Amount of their Stocks was £. 100. D's Gain £. 3, E's £. 5, and F's £. 8; What was each Man's Stock? Facit D's £. 18 - 15, E's £. 31 - 5, and F's £. 50.

Such a Question as this is resolved by adding each Partner's given Gain or Loss to one Total; then say, as this Total: the given Amount of the Stock :: each Partner's given Gain or Loss: his required Stock.

CONJOINED PROPORTION

Teaches, by a single Operation, to find an Answer which otherwise could only be obtained by several Rules of Three.

RULE.

CONJOINED PROPORTION. 141

RULE. Make two Columns; one on the Left-Hand, which call *Antecedent*, and the other on the Right-Hand, which call *Consequent*; place the Numbers alternately, beginning at the Left-Hand; and observe, that the first Antecedent, and the last Consequent, whether given or sought, must be of the like Species; so must the second Consequent, and the third Antecedent; and this Order must be continued throughout the Whole. Then, if it is required to find *how many of the first Sort are equal to a given Quantity of the last Sort*, you must let the last Number be at the *Antecedent*; multiply the *Antecedents* together for a *Dividend*, and the *Consequents* for a *Divisor*: But, if it is required to find *how many of the last Sort are equal to a given Quantity of the first Sort*; on the contrary, let the last Number be at the *Consequent*; multiply the *Antecedents* for a *Divisor*, and the *Consequents* for a *Dividend*.

EXAMPLES.

I. Suppose London is to remit in Spain $2875\frac{1}{2}$ Piaftres of 272 Mervadies, by the Way of Holland, at 35s. per £. Thence, by the Way of France, at 58 Groats per Crown. Thence, to Venice, at 100 Crowns per 60 Ducats Banco. And from Venice to Spain, at 360 Mervadies per Ducat Banco. How much Sterling will it amount to in London, exclusive Charges? Facit £.500 - 0 - 10 $\frac{1}{4}$ + $\frac{1}{7}$.

<i>Ant.</i>	<i>Cons.</i>
1 Pound Sterling =	35s. or 420 d. Holland.
58 Groats =	1 Crown.
100 Crowns =	60 Ducats.
1 Ducat =	360 Mervadies.
272 Mervadies =	1 Piaftre.
2875 $\frac{1}{2}$ Piaftres =	Pounds Sterl. sought.

$$58 \times 100 \times 272 \times 2875\frac{1}{2} = 45363888|00;$$

$$\text{and } 420 \times 60 \times 360 = 90720|00$$

$$\text{Then, } 45363888 \div 90720 = \text{£.}500 - 0 - 10\frac{1}{4} + \frac{12960}{90720} = \frac{1}{7}$$

II. If 30s. are the Price of 5 Canes of Languedoc; 9 Canes of Languedoc making $26\frac{1}{4}$ Ells of Holland; 7 Ells of Holland 4 Ells of Paris; 5 Ells of Paris 6 Ells of Rouen. How many Ells of Rouen may I have for 60s? Facit 20.

<i>Ant.</i>	<i>Cons.</i>
30s. =	5 Canes of Languedoc.
9 Canes of Languedoc =	$26\frac{1}{4}$ Ells of Holland.
7 Ells of Holland =	4 Ells of Paris.
5 Ells of Paris =	6 Ells of Rouen.

How many Ells of Rouen may I have for 60s.

$$30 \times 9 \times 7 \times 5 = 945|0; \text{ and } 5 \times 26\frac{1}{4} \times 4 \times 6 \times 60 = 18900|0.$$

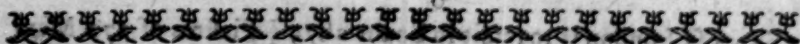
$$\text{Then, } 18900 \div 945 = 20.$$

III. If

III. If 30s. are the Price of 5 Canes of Languedoc; 9 Canes of Languedoc making $26\frac{1}{4}$ Ells of Holland; 7 Ells of Holland 4 Ells of Paris; 5 Ells of Paris 6 Ells of Rouen; What will be the Price of 20 Ells of Rouen? Facit 60s.

IV. If 1 Pound Sterling = 420d. Holland, and 58 Groats, Holland = 1 Crown, France; and 100 Crowns, France = 60 Ducats Banco, Venice; and 1 Ducat Banco = 360 Mervadies, Spain; and 272 Mervadies = 1 Piastre; How many Piastrs will be equal to £.500 - 0 - 10 $\frac{1}{4}$ $\frac{1}{2}$. Sterling? Facit 287 $\frac{1}{2}$.

V. If 7 Ells of Paris make 9 Yards of London; 36 Yards of London 49 Ells of Holland; 7 Ells of Holland 9 Braces of Milan; 3 Braces of Milan 2 Wares of Arragon; 5 Wares of Arragon 2 Canes of Montpellier; 9 Canes of Montpellier 10 Canes of Thoulouse; and 4 Canes of Thoulouse 9 Ells of Champagne: How many Ells of Paris will be equal to 150 Ells of Champagne? Facit 100.



ALLIGATION or RULE of MIXTURES

Teaches to proportion the Price of a Mixture to the several Prices of the Simples, or to find the Quantity of each Ingredient, which will proportion the Mixture to a certain Price.

CASE I. When the Quantity of each Ingredient is the same.

RULE. Add the Prices together and divide the Total by the Number of Quantities,

EXAMPLES.

I. A Grocer mixes Tea at 5s. at 8s. at 3s. and at 6s. per lb. What will a lb. of the Mixture be worth? Facit 5s. 6d.

$5 + 8 + 3 + 6 = 22$ s. which divided by 4, because there are 4 Prices = 5s. 6d.

II. A Grocer has mixed Sugar at 50s. per cwt. at 60s. per cwt. and at 70s. per cwt. What is 1 cwt. of the Mixture worth? Facit 60s.

CASE II. When the Quantities as well as the Prices are different

RULE. Multiply each Ingredient by its Price, add the Products together, and divide the Product by the Total of the Quantities.

EXAMPLES.

I. A Grocer has mixed 346lbs. of Sugar at 7d. per lb. and 234lbs. at 6d. per lb. What is a lb. of the Mixture worth? Facit 6 $\frac{1}{2}$ d.

346lbs.

or, RULE of MIXTURES. 143

346lbs.	And, 234lbs.	346	Therefore, 2472d.
at 7d.	at . . 6	234	1404
<u>2422</u>	<u>1404</u>	<u>580</u>	<u>3826 (6 $\frac{1}{2}$)</u>
			346
			4
			<u>1384</u>
			224

II. If 130 Gallons of Brandy, at 11s. 6d. a Gallon, were mixed with 87 Gallons, at 9s. 3d. a Gallon; What would a Gallon of the Mixture be worth? Facit 10s. 7 $\frac{1}{2}$ d. +

III. A Grocer has 60lbs. of Almonds, at 5 $\frac{1}{2}$ d. per lb. 58lbs. of another kind, at 5 $\frac{1}{4}$ d. 46lbs. at 4 $\frac{1}{4}$ d. and 180lbs. of Raisins, at 4d. per lb. If these were mixed together, What would a lb. be worth? Facit 4 $\frac{1}{2}$ d. +

IV. A Refiner has 15lbs. of Silver Bullion of 8oz. fine; 30lbs. of 7oz. fine; and 45lbs. of 6oz. fine. If these were all melted together, What Fineness will 1lb. of the Mass be? Facit 6oz. 13dwts. 8gr. fine.

V. A Goldsmith has 48oz. of Gold, at £.4 per oz. 32oz. at £.4 - 5 per oz. 24oz. at £.4 - 6 - 8 per oz. and 36oz. at £.4 - 13 - 4 per oz. which he melts altogether, What is an oz. of the Composition worth? Facit £.4 - 5 - 8 $\frac{1}{2}$ + $\frac{2}{7}$.

CASE III. To increase or lessen a Compound proportionally, the several Quantities of the Simples in the Composition being given.

RULE. As the Total of the Quantities of the given Compound: the Whole Quantity proposed to be increased or lessened :: each particular Quantity in the given Compound: the Proportion required. As for Instance,

Suppose the Compound, in the last Question, was to be lessened to 48oz. How much must be taken of each Ingredient?

As 140 : 48 :: 48 : 16oz. 9dwts. 3 $\frac{1}{2}$ gr. at £.4 *Answers.*

140 : 48 :: 32 : 10 - 19 - 10 $\frac{2}{7}$ at £.4 - 5

140 : 48 :: 24 : 8 - 4 - 13 $\frac{1}{7}$ at £.4 - 6 - 8

140 : 48 :: 36 : 12 - 6 - 20 $\frac{2}{7}$ at £.4 - 13 - 4

PROOF. 48 - 0 - 0

But, if the Compound, instead of being lessened, was to be increased to 180oz. How much is to be taken of each Ingredient?

Facit 61oz. 14dwts. 6 $\frac{6}{7}$ gr. at £.4 - 41oz. 2dwts. 20 $\frac{2}{7}$ gr. at £.4 - 5 - 30oz. 17dwts. 3 $\frac{1}{2}$ gr. at £.4 - 16 - 8, and 46oz. 5dwts. 17 $\frac{1}{2}$ gr. at £.4 - 13 - 4.

CASE

CASE IV. The Total of the Composition being given, to find how much of each Simple is in any Part of the Composition.

RULE. As the Total of the Composition, is to any Part of the Composition; so, the Quantity of each Simple is to the Quantity required.

EXAMPLE.

How much of each Ingredient is in a *lb.* or 12oz. of Gold, at the Prices mentioned in the last EXAMPLE, when there are 140oz. in the Composition?

As 140 : 12 :: 48 : — | So, $12 \times 48 = 576\text{oz.}$
 :: 32 | $140 = 20 \times 7$, So, } $210 \div 28 = 16\text{dwts.}$
 :: 24 | } $77 \div 4 = 2 - 6 \frac{6}{7}$
 :: 36 |
Answers. 48 = 4oz. 2dwts. 6 $\frac{6}{7}$ gr. at £. 4.
 32 = 2 - 14 - 20 $\frac{2}{7}$ at £. 4 - 5
 24 = 12 - 1 - 3 $\frac{2}{7}$ at £. 4 - 6 - 8
 36 = 3 - 0 - 17 $\frac{1}{7}$ at £. 4 - 13 - 4

12 - 0 - 0

CASE V. The particular Rates of a Number of Ingredients to be mixed, and the Rate of the Mixture being given, to find how much of each Ingredient must be taken to compose the Mixture.

RULE. Make two Columns: at the first write down the Numbers which are greater than the Mean: at the other write down those which are less than the Mean. Then, take the lowest of the lower Numbers, which place for first Term. Take also the lowest of the higher Numbers, which place below the other: make a Cross after them, one Stroke of which may be over against the first Term, the other over against the second Term. Afterwards, take the Difference betwixt the first Term and the given mean Number, which Difference write down against the second Term, at the Bottom of that Line of the Cross which descends straight to the Right of that second. Then, take likewise the Difference betwixt the second Term and the same mean Number, which Difference write down against the first Term, at the End of that Line of the Cross which ascends straight to the Right of that first. Thus, proceed for every Couple; and, when you have found all the Differences, add them up together, the Total will be that of the Mixtures, and the several Differences will shew the Quantity of each Ingredient to be taken to compound the Mixture. But observe, that if the Number of Ingredients is odd, you are to repeat the odd Number with one of the others, with a less if that

Number

or, RULE of MIXTURES. 145

Number is greater than the Mean, and with a greater if that Number is less than the Mean.

EXAMPLES.

I. Suppose you had Sugar at 4d. at 7d. at 8d. and at 5d. per lb. And, that you had rather mix the 4 Sorts together, so as to sell the Compound 6d. per lb. What Quantity of each must be taken?

	7d. } higher	4d. } lower.	
	8	5	
	Mean.	Answers.	Proof.
4	Difference from 4 to 6	1 at 4d. =	4d.
7	Difference from 7 to 6	2 at 7 =	14
5	Difference from 5 to 6	2 at 5 =	10
8	Difference from 8 to 6	1 at 8 =	8
		6lbs. at 6d.	36d. =

II. Having Tea at 4s. at 3s. and at 2s. per lb. How much must be taken of each to make a Mixture worth 2s. 6d. a lb.?

By reducing the Shillings to Pence it will be thus :

	36d. } higher.	24	
	48	24 repeated	} lower.
24	Difference to the Mean	30	6 at 2s. = 12
36	Difference to	30	6 at 3 = 18
24	Difference to	30	18 at 2 = 36
48	Difference to	30	6 at 4 = 24
		36 at 2s. 6d.	= 90s.

III. A Vintner has Rum at 10s. at 13s. at 9s. and at 14s. per Gallon, What Quantity of each must be taken to have some at 11s. ? Facit 2 at 9s. 2 at 13s. 3 at 10s. and 1 at 14s.

IV. A Grocer has Tea at 5s. at 4s. at 6s. at 10s. at 8s. and at 9s. per lb. He proposes to make a Mixture of the Whole to sell it at 7s. per lb. What Quantity of each must he take? Facit 1 lb. at 4s. 3 at 8s. 2 at 5s. 2 at 9s. 3 at 6s. and 1 at 10s.

V. A Goldsmith has Gold at £. 4, some at £. 4 - 5, some at £. 4 - 1, and some at £. 4 - 2 - 6, per oz. He wants to make a Mixture of the Whole, which may stand him in £. 4 - 2 per oz. How many oz. of each Sort must he take to answer his Purpose? Facit 6oz. at £. 4, 24 at £. 4 - 2 - 6, 36 at £. 4 - 1, and 12 at £. 4 - 5.

VI. A Vintner has 5 sorts of Burgundy, which he values some at 4s. some at 5s. some at 6s. some at 10s. and some at 12s. per Bottle. But as he should like to have some at 8s. a Bottle, How much of each must he take? Facit 2 Bottles at 4s. 4 at 5s. 4 at 6s. 4 at 10s. and 5 at 12s.

CASE VI. The mean Price, the particular Prices of each Ingredient and the Quantity of one kind being given, to find the Quantity of each other Ingredient.

RULE. First find, as in last Case, what Quantities would solve the Question. Then, say: as the Difference of that simple whose Quantity is given : each Difference :: the given Quantity : the several Quantities sought.

EXAMPLES.

I. A Vintner has 20 Gallons of bad Brandy, at 4s. per Gallon; which, as he can not sell it, he would mix with some at 12s. some at 10s. and some at 6s. per Gallon: How much of each Sort must he take to have another Sort at 8s. per Gallon?

Higher.	Lower.		Gallon.
10	4	4	Difference to 8 $\times 2$
12	6	10	Difference to 8 $\times 4$
		6	Difference to 8 $\times 4$
		12	Difference to 8 $\times 2$

As 2, Difference of the given Simple, 20 Gallons: 4, next Difference :: 20, Quantity of the given Simple : 40 Gallons, Answer for the Sort at 10s.

As 2, same Difference :: 4, third Difference :: 20, same Quantity : 40, Answer for the Sort at 6s.

As 2, same Difference :: 2, fourth Difference :: 20, same Quantity : 20, Answer for the Sort at 12s.

II. Suppose a Grocer with 40lbs. of best Tea, at 12s. per lb. would mix two other Sorts, one at 7s. and one at 4s. per lb. and sell the Mixture at 8s. per lb. What Quantity must he take of each? Facit 32lbs. at 7s. 32 at 4s. and 40 at 12s.

CASE VII. The mean Price, the particular Prices of each Ingredient, and the Quantity of the intended Mixture being given, to find the particular Quantity of each Ingredient.

RULE. First find, as in CASE IV. what Quantities would solve the Question; then, say: as the Total of the Differences : the Whole Quantity given :: each particular Difference : its particular Quantity required.

EXAMPLES.

I. How many lbs. of Sugar, at 4d. at 7d. at 8d. and at 5d. must be taken to compound a Mixture of 48lbs. at 6d. each?

6	4	$\times 1$	As 6lbs. : 48 :: 1lb. : 8lbs. at 4d. = 32
6	7	$\times 2$	:: 2 : 16 at 7 = 112
6	5	$\times 2$	:: 2 : 16 at 5 = 80
6	8	$\times 1$	:: 1 : 8 at 8 = 64
			48 at 6d. = 288d.

II. How

II. How many Bottles of Burgundy, at 4, 5, 6, 10, and 12s. per Bottle, must be taken, to make a Mixture of 560 Bottles, at 8s. each? Facit $58\frac{1}{9}$ at 4s. $117\frac{1}{9}$ at 10s. $147\frac{7}{9}$ at 12s. $117\frac{1}{9}$ at 6s. and $117\frac{1}{9}$ at 5s.



ARITHMETICAL PROGRESSION.

These Numbers 1, 2, 3, 4, are in Arithmetical Progression, by the continual Increasing of one; and, 4, 3, 2, 1, are also in Arithmetical Progression, by the continual Decreasing of one. Again, 3, 6, 9, 12, are in Arithmetical Progression, by the continual Increasing of 3; and, 16, 12, 8, 4, are in Arithmetical Progression, by the continual Decreasing of 4. That Difference is called *Ratio* or *common Difference*.

In any Series of Figures in Arithmetical Progression, when the Number of Terms is even, the Sum of the two Extrems will be equal to the two middle Numbers or any two Means equally distant from the Extrems.—When the Number of Terms is odd, the Double of the Middle will be equal to the two Extrems.

EXAMPLES.

3, 5, (7, 9), 11, 13, *even Number*.

So, $7+9=16$, and $3+13=16$, and $5+11=16$.

4, 8, (12), 16, 20, *odd Number*.

So, $12+12=24$, and $4+20=24$; and $8+16=24$.

In Arithmetical Progression, observe five Things, *viz.* 1st, the *first Term*; 2d, the *last Term*; 3d, the *Number of Terms*; 4th, the *common Difference*, and 5th, the *Sum of all the Terms*.—When any three of them are given, the other two may be found by the following Rules:

I. The *first*, *second* and *third* being given, to find the *fifth* or *Sum of all the Terms*. Multiply the Sum of the two Extrems by half the Number of Terms; or, multiply the Whole Number of Terms by half the Sum of the two Extrems.

II. The 1st, 2d, and 3d being given, to find the 4th or *common Difference*. Subtract the 1st from the 2d, and divide the Remainder by the 3d less one, for the Answer.

III. The 1st, 2d, and 4th being given, to find the 3d or *Number of Terms*. Subtract the 1st from the 2d, divide the Remainder by the 4th, and to the Quotient add 1.

IV. The 2d, 3d, and 4th being given, to find the *first Term*. Multiply the 4th, by the 3d less 1, and subtract the Product from the 2d.

148 ARITHMETICAL PROGRESSION.

V. The 2d, 3d, and 5th being given, to find the *first Term*. Divide the 5th by the 3d, and from the Quotient, subtract half the Product of the 4th multiplied by the 3d less 1.

VI. The 1st, 3d, and 4th being given, to find the *second Term*. Multiply the Number of Terms less 1 by the common Difference, and add the first.

EXAMPLES.

I. A Man buys 17 Yards of Cloth, and gave for the 1st Yard 2s. and for the last 10s. What did the 17 Yards amount to? Facit £. 5 - 2.

1st Term, 2s. + last Term 10s. = 12s.

So, 12s. $\times 8 \frac{1}{2}$ (Half of 17, Number of Terms) = 102s.

Or, 17 Number of Terms $\times$ 6 half of the two Extreams = 102s. or, £. 5 - 2.

II. Suppose 12 Eggs were laid in a straight Line, at one Yard's Distance from each other; and the first Egg, one Yard's Distance, the last 12 Yards, from a Basket, into which a Man is to carry them one by one: How many Yards must he Walk? Facit 156.

Since the Man must come back again, when he has walked 1 Yard, the common Difference is 2, and therefore the last Term must be 24, As, $2 \times 12 = 24$.

III. A Man is to travel from London to a certain Place in 16 Days, and go 4 Miles the first Day, increasing every Day by an equal Number, so that the last Day's Journey may be 64 Miles; What is the daily Increase? Facit 4.

64 last Day - 4 Miles 1st Day = 60 $\div$ the Number of Days - 1, Or, 15 = 4.

IV. A Man going to a certain Place, went 4 Miles the 1st Day, and increased every Day by 4 Miles, so that the last Day he went 64 Miles: How many Days was he upon his Journey? Facit 16.

64 Miles, last Day - 4 Miles, 1st Day = 60 $\div$ 4 common Difference = 15 + 1 = 16.

V. A Man, in 16 Days, went from London to a certain Place, every Day's Journey increasing the former by 4, and the last he went 64 Miles: What was the first? Facit 4.

4 common Difference $\times$ the Number of Days - 1, or, 15 = 60, which subtracted from 64, give 4.

VI. A Man is to go to a certain Place, 544 Miles Distance from London, in 16 Days, and he intends to go 4 Miles every Day more than the former: How many Miles will he go the first Day? Facit 4.

544 $\div$ 16 = 34; and, $4 \times 16 - 1 = 60$, the Half of which is 30, So, 34 - 30 = 4.

VII. What

VII. What is the last Number of an Arithmetical Progression, beginning at 4, and continuing by the Increase of 4 to 16 Places? Facit 64.

$$16 - 1 = 15, \text{ So, } 15 \times 4 = 60. + \text{ the 1st Term } 4 = 64.$$

GEOMETRICAL PROGRESSION.

These Numbers, 1, 3, 9, 27, 81, are in Geometrical Progression by the continual multiplying by 3; and, 32, 16, 8, 4, 2, 1, are likewise in Geometrical Progression by the continual dividing by 2.

In any Series of Figures in Geometrical Progression, when the Number of Terms is even, the Product of the two Extrems will be equal to that of two middle Numbers, or any two Means equally distant from the Extrems. When the Number of Terms is odd, then the Product of the two Extrems, will be equal to the Square of the Middle Number, or to the Product of any two Means equally distant from the Extrems.

EXAMPLES.

32, 16, (8, 4), 2, 1, *even Number.*

So, $4 \times 8 = 32$, and $1 \times 32 = 32$, and $2 \times 16 = 32$

1, 3, (9), 27, 81, *odd Number.*

So, $9 \times 9 = 81$, and $81 \times 1 = 81$, and $27 \times 3 = 81$

In Geometrical Progression, the same five Things are to be observed, as in Arithmetical.

RULE. In a long Series of Numbers, it being very tedious by continual Multiplication to find the last Term, make Use of a Series of *Indices* or Numbers in Arithmetical Progression, beginning with an Unit, whose common Difference be one. Then, place under these Indices as many Numbers in such Geometrical Progression as is given in the Question, thus:

1. 2. 3. 4. 5. 6. 7. 8. are *Indices.*

2. 4. 8. 16. 32. 64. 128. 256. are in *Geometrical Progression.*

But observe that, when the first Term in Geometrical Progression is different from the Ratio or common Difference, the Indices must begin with a Cypher; and, then the Quantity of Indices made choice of, must be one less than the Number of Terms given in the Question; 1, in the Indices being over the second Term; 2, over the third, &c. thus:

0. 1. 2. 3. 4. 5. 6. 7. will be *Indices.*

1. 2. 4. 8. 16. 32. 64. 128. in *Geometrical Progression.*

Now,

150 GEOMETRICAL PROGRESSION.

Now, the Use of these Tables is such, that if you add any two Indices together, that Sum will correspond to the Product of their respective Terms.

EXAMPLES.

Indices	3 + 5 = 8	} First Table.
Numbers in Geometrical Progression.	8 × 32 = 256	
Indices	3 × 4 = 7	} Second Table.
Numbers in Geom. Progression	8 × 16 = 128	

Hence it results, that if it was required to find the Amount of a 13th Term.

Indices	6 + 7 = 13	} First Table.
Geometrical Numbers . .	64 × 128 = 8192	
	6 + 6 = 12	} Second Table.
	64 × 64 = 4096	

It is then easy to perceive, that by the Help of these Indices, and a few of the first Terms in any Series of Geometrical Progression, the Sum of any remote Term may speedily be obtained without producing all the Terms.

NOTE. If the Sum of all the Numbers is required, multiply the last Number by the common Difference; from the Product, subtract the first Term, and divide the Remainder by the Ratio less 1.

EXAMPLES.

I. A Man skilled in Numbers met with another, who expressing a great Desire of buying his Coat, he agreed to let him have it, if he should give him only the Price of the 16th Button, reckoning 1d. for the first Button, 2d. for the second, 4d. for the third, and the Rest thus, in double Proportion; How much did he sell his Coat? Facit £. 136 - 10 - 8.

0.	1.	2.	3.	4.	5	}	3 + 5 = 8		
1.	2.	4.	8.	16.	32		8 × 32 =		256d.
							2 + 5 = 7		
							4 × 32 =		128

							15		2048
Though 8 + 7 make only 15, yet because the Indices									3072
begin with a Cypher, the Product = that of									
16 =									32768d.

Or, £. 136 - 10 - 8

II. A Man sold a House, where were 12 Rooms, on Condition that the Purchaser should pay only 3d. for the first Room, 9d. for the

151

1. 2. 3. 4. 5. 6. } $6 + 6 = 12$
 3. 9. 27. 81. 243. 729. } $729 \times 729 = 531441d.$
 Multiply by the *common Difference* 3

Subtract *first Term* . . . $\begin{array}{r} 15943^{23} \\ 3 \\ \hline 15943^{20} \end{array}$ $\div$ the Ratio

The Ratio being only 2, there will be no Need to divide by it, for 2 less
1 = 1 Divisor.

PERMUTATION

EXAMPLES.

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$$

$$2. \quad 6. \quad 24. \quad 120. \quad 720. \quad 5040. \quad 40320.$$

II. How many Changes may be rung on 7 Bells? Facit 5040.

III. A Gentlemen desirous to Board in a genteel Family, demanded what were the Terms for a Year. Being answered £. 100, he cunningly asked what he must give for so long as himself and 8 other Gentlemen of his Friends could sit every Day at Dinner, in a different Order. The Host thinking it would not be long, told him £. 15, to which they agreed. How long were they to board in the House? Facit 362880 Days.

THE END OF THE THIRD PART.

PERMUTATION

the second, and thus making the first to the last. In the first place, the first is the first, and the second is the second, and so on, until the last is the last. This is the first principle of permutation, and it is the foundation of all the other principles.

Secondly, the first is the first, and the second is the second, and so on, until the last is the last. This is the second principle of permutation, and it is the foundation of all the other principles.

Thirdly, the first is the first, and the second is the second, and so on, until the last is the last. This is the third principle of permutation, and it is the foundation of all the other principles.

PERMUTATION

Fourthly, the first is the first, and the second is the second, and so on, until the last is the last. This is the fourth principle of permutation, and it is the foundation of all the other principles.

Fifthly, the first is the first, and the second is the second, and so on, until the last is the last. This is the fifth principle of permutation, and it is the foundation of all the other principles.

Sixthly, the first is the first, and the second is the second, and so on, until the last is the last. This is the sixth principle of permutation, and it is the foundation of all the other principles.

Seventhly, the first is the first, and the second is the second, and so on, until the last is the last. This is the seventh principle of permutation, and it is the foundation of all the other principles.

The first is the first, and the second is the second, and so on, until the last is the last. This is the eighth principle of permutation, and it is the foundation of all the other principles.

THE FOURTH PART.

FRACTIONAL ARITHMETIC.



OF VULGAR FRACTIONS.

A VULGAR FRACTION, is a broken Number; that is, a Part or Parts of an Integer or Whole Number; and, consists of two Things, viz. the *Numerator* and the *Denominator*. The *Numerator* always stands a-top; and, is called so from its expressing the Number of Parts there is of a Whole.

The *Denominator* always stands under the *Numerator*; and is called so from its expressing the *Ratio*, and denoting in how many Parts the Whole is divided.

Thus in $\frac{2}{3}$, $\frac{3}{4}$; 2 and 3 are the *Numerators*, and, 5 and 7 are *Denominators*.

There are four Sorts of Vulgar Fractions, viz. *Proper*, *Improper*, *Compound* and *Mixed*.

A *Proper Fraction* has its Numerator less than, or not equal to, its Denominator; thus, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{3}$ are *Simple* or *Proper Fractions*.

An *Improper Fraction* has its Numerator greater than, or equal to, its Denominator; thus, $\frac{3}{2}$, $\frac{5}{4}$, $\frac{7}{3}$ are *Improper Fractions*.

A *Compound Fraction* is a *Fraction* of a *Fraction* joined together by the Word *of*; thus, $\frac{2}{3}$ of $\frac{5}{6}$, or, $\frac{1}{6}$ of $\frac{3}{4}$ of $\frac{2}{3}$, are *Compound Fractions*.

A *Mixed Fraction* is composed of a Numerator, considered as Whole Number, and a Fraction; or, of a Denominator, considered as Whole Number, and a Fraction; thus, $36\frac{2}{3}$ and $19\frac{1}{3}$ are *Mixed Fractions*.—

By the same Reason, A *Mixed Number* is composed of a Whole Number and a Fraction; thus, $10\frac{2}{3}$, or $16\frac{1}{2}$, are *Mixed Numbers*.

REDUCTION OF VULGAR FRACTIONS.

CASE I. *To reduce a Whole Number to an Improper Fraction.*

RULE. Multiply the Whole Number by the Number of Parts you want it to be brought to, and place the Product over the Figure you multiplied by.

EXAMPLES.

- I. Reduce 36 into Sixths. Facit $2\frac{16}{6}$ | II. Reduce 35 into 7ths. Facit $2\frac{45}{7}$.
 $36 \times 6 = 216$ |

N. B. To express a Whole Number Fraction-ways, set 1 for Denominator. Thus, 3, 4, &c. will be $\frac{3}{1}$, $\frac{4}{1}$, &c.

CASE II. *To reduce a Mixed Number to an Improper Fraction.*

RULE. Multiply the Whole Number by the Denominator of the Fraction taking in its Numerator. Then, place the Denominator under the Total.

EXAMPLES.

- I. Reduce $450\frac{3}{5}$ to an Improper Fraction. Facit $225\frac{3}{5}$.
 $450 \times 5 + \text{the Numerator } 3 = 2253$, new Numerator.
 II. Reduce $36\frac{7}{8}$ to an Improper Fraction. Facit $3\frac{3}{8}$.

CASE III. *To reduce an Improper Fraction to a Whole or Mixed Number, that is, to its proper Terms.*

RULE. Divide the Numerator by the Denominator. The Quotient will quote the Wholes; and if any Thing remains, place it, for Numerator, over the Denominator.

This Case is a Proof to the first and second Cases.

EXAMPLES.

- I. How many Wholes are there in $2\frac{16}{6}$? Facit 36.
 $6) 216$
 II. Reduce $22\frac{53}{5}$ to its proper Terms. Facit $450\frac{3}{5}$.
 $5) 2253$
 $450 + 3$
 III. How many Wholes are there in $2\frac{45}{7}$? Facit 35.
 IV. How many Wholes are there in $3\frac{3}{8}$? Facit $36\frac{7}{8}$.

CASE

CASE IV. *To reduce a Mixed Fraction to a single one, the Numerator being the Integral Part.*

RULE. Multiply the Numerator considered as Integer by the Denominator of the Fractional Part, taking in the Numerator of that Fractional Part, and you'll have a new Numerator. Then, multiply the Denominator of the Integral Part by the Denominator of that Fractional Part, for a new Denominator.

EXAMPLES.

I. Reduce $25\frac{5}{6}$ to a simple Fraction. Facit $\frac{155}{6}$.

$25 \times 6 + \text{the Numerator } 5 = 155 \text{ new Numerator.}$

$36 \times 6 = \dots\dots\dots 216 \text{ new Denominator.}$

II. Reduce $35\frac{3}{4}$ to a simple Fraction. Facit $\frac{143}{4}$.

CASE V. *To reduce a Mixed Fraction to a single one, the Denominator being the Integral Part.*

RULE. Multiply the Numerator of the Integral Part by the Denominator of the Fractional, for a new Numerator. Then, multiply the Denominator considered as Integer by the Denominator of the Fractional Part, taking in the Numerator of that Fractional Part, and you'll have a new Denominator.

EXAMPLES.

I. Reduce $55\frac{1}{3}$ to a simple Fraction. Facit $\frac{166}{3}$.

$55 \times 3 = \dots\dots\dots 165 \text{ new Numerator.}$

$128 \times 3 + \text{the Numerator } 1 = 385 \text{ new Denominator.}$

II. Reduce $3\frac{1}{4}$ to a simple Fraction. Fraction $\frac{13}{4}$.

CASE VI. *To reduce a Compound Fraction to a simple one.*

RULE. Multiply all the Numerators together for a new Numerator, and all the Denominators for a new Denominator.

EXAMPLES.

I. Reduce $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$ to a simple Fraction. Facit $\frac{105}{192}$.

Numerators $3 \times 5 \times 7 = 105 \text{ new Numerator.}$

Denominators $4 \times 6 \times 8 = 192 \text{ new Denominator.}$

II. Reduce $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$ to a simple Fraction. Facit $\frac{105}{192}$.

by 2 continually, while possible; Numbers with Cyphers may have an equal Number cut off from each, and afterwards be divided when possible; Numbers ending in 5, or 5 and Cypher may be divided by 5.—Again, even Numbers divide by even Numbers, and odd Numbers divide by odd Numbers.

EXAMPLES.

III. What is the lowest Terms of the Fraction $\frac{27}{36}$? Facit $\frac{3}{4}$.

$$9) \frac{27}{36} (\frac{3}{4})$$

First, I cut off the Cypher in both the Numerator and the Denominator, then as 9 is contained in both 27 and 36 without a Remainder, so, 9 is the common Measure.

IV. What is the lowest Terms of $\frac{44}{88}$? Facit $\frac{1}{2}$.

$$\text{First, } 4) \frac{44}{88} (\frac{1}{2}) \quad \text{Secondly, } 2) \frac{11}{22} (\frac{1}{2})$$

V. Reduce $\frac{4}{8}$ to its lowest Terms. Facit $\frac{1}{2}$.

VI. Reduce $\frac{6}{12}$ to its lowest Terms. Facit $\frac{1}{2}$.

VII. Reduce $\frac{8}{16}$ to its lowest Terms. Facit $\frac{1}{2}$.

VIII. Reduce $\frac{2}{4}$ to its lowest Terms. Facit $\frac{1}{2}$.

IX. Reduce $\frac{7}{14}$ to its lowest Terms. Facit $\frac{1}{2}$.

X. Reduce $\frac{17}{34}$ to its lowest Terms. Facit $\frac{1}{2}$.

N. B. If the Numerator and Denominator of a Fraction be both multiplied by any same Number at Pleasure, the Products will give a Fraction in greater Terms, yet in the same Proportion: thus, $\frac{3}{4} \times 32 = \frac{96}{128}$; and $\frac{96}{128} = \frac{3}{4}$.

CASE VIII. To reduce a Fraction of one Denomination to another of the same Value, the Numerator of the required Fraction being given.

RULE. Multiply the Denominator by the intended Numerator, and divide by the other Numerator. The Quotient will give the Denominator required.

EXAMPLES.

I. Reduce $\frac{3}{4}$ to a Fraction, whose Numerator be 12. Facit $\frac{9}{16}$. which equal $\frac{3}{4}$.

$$4 \times 12 = 48 \div 3 = 16 \text{ Denominator required.}$$

II. Reduce $\frac{5}{8}$ to a Fraction, whose Numerator be 55. Facit $\frac{55}{128}$

CASE IX. To reduce a Fraction of one Denomination to another of the same Value, the Denominator of the required Fraction being given.

RULE. This being the Reverse of the last Case (and its Proof), multiply the Numerator by the intended Denominator, and divide by the other Denominator. The Quotient will give the Numerator required.

EXAMPLES.

EXAMPLES.

I. Reduce $\frac{3}{4}$ to a Fraction, whose Denominator be 16. Facit $\frac{12}{16}$.

$$3 \times 16 = 48 \div 4 = 12 \text{ Numerator required.}$$

II. Reduce $\frac{1}{3}$ to a Fraction, whose Denominator be 128 $\frac{1}{3}$. Facit

$$\frac{55}{128} \frac{1}{3}$$

CASE X. To reduce several Fractions to a common Denominator.

RULE. Multiply each Numerator into all the Denominators, except its own, for a new Numerator. Then, multiply all the Denominators together for a new Denominator.

EXAMPLES.

I. Reduce $\frac{3}{4}$, $\frac{2}{5}$, $\frac{4}{6}$ and $\frac{1}{3}$, to a common Denominator. Facit

$$\frac{270}{360}, \frac{144}{360}, \frac{240}{360} \text{ and } \frac{120}{360}.$$

$$3 \times 5 \times 6 \times 3 = 270 \quad 270 \quad 144 \quad 240 \quad 120 \text{ new Numerator.}$$

$$2 \times 4 \times 6 \times 3 = 144$$

$$4 \times 3 \times 5 \times 4 = 240$$

$$1 \times 6 \times 5 \times 4 = 120$$

$$4 \times 5 \times 6 \times 3 = 360$$

360 new Denominator.

The Numerator of the first Fraction $\frac{3}{4}$, multiplied by $5 \times 6 \times 3$ Denominators of the other Fractions $= 270$, which I place over the $\frac{3}{4}$.

The Numerator of the second Fraction $\frac{2}{5}$, multiplied by $4 \times 6 \times 3$ Denominators of the other Fractions $= 144$, which I place over the $\frac{2}{5}$.

The Numerator of the third Fraction $\frac{4}{6}$, multiplied by $3 \times 5 \times 4$ Denominators of the other Fractions $= 240$, which I place over the $\frac{4}{6}$.

The Numerator of the fourth Fraction $\frac{1}{3}$, multiplied by $6 \times 5 \times 4$ Denominators of the other Fractions $= 120$, which I place over the $\frac{1}{3}$.

Thus, having found the new Numerators, to have their new common Denominator, I multiply all the Denominators 4, 5, 6, 3, into one another, and place the Product 360 under the given Fractions.

II. Reduce $\frac{2}{3}$ and $\frac{3}{5}$ to a common Denominator. Facit $\frac{40}{60}$ and $\frac{36}{60}$.

III. Reduce $\frac{2}{6}$, $\frac{1}{3}$, $\frac{2}{5}$ and $\frac{3}{4}$ to a common Denominator. Facit $\frac{720}{2160}$, $\frac{1200}{2160}$, $\frac{864}{2160}$ and $\frac{1296}{2160}$.

IV. Reduce $\frac{2}{3}$, $\frac{9}{10}$ and $\frac{11}{12}$ to a common Denominator. Facit $\frac{840}{960}$, $\frac{864}{960}$ and $\frac{880}{960}$.

V. Reduce $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{5}$ and $\frac{1}{6}$ to a common Denominator. Facit $\frac{972}{1440}$, $\frac{1080}{1440}$, $\frac{288}{1440}$ and $\frac{105}{1440}$.

VI. Reduce

VI. Reduce $\frac{4}{9}$, $\frac{7}{11}$, $\frac{6}{7}$ and $\frac{1}{2}$ to a common Denominator. Facit $\frac{616}{1386}$, $\frac{882}{1386}$, $\frac{1188}{1386}$ and $\frac{693}{1386}$.

CASE XI. *A Fraction of any known Denomination being given, to find its proper Fraction to the Whole or Integer.*

RULE. Make the given Parts into a compound Fraction, by ascending from the less to the greater Denomination. Then, reduce that compound Fraction to a simple one as by CASE VI.

EXAMPLES.

I. Reduce $\frac{3}{4}$ of a Penny to the Fraction of a £. Sterling. Facit $\frac{3}{960} = \frac{1}{320}$.
Here, because 12d. make 1s. and 20s. make 1 £. I say, $\frac{3}{4}$ of $\frac{1}{20}$ of $\frac{1}{12}$.

$$\text{Then, } 3 \times 1 \times 1 = 3 \\ 4 \times 12 \times 20 = 960$$

II. Reduce $\frac{5}{8}$ of a Penny to the Fraction of a £. Sterling. Facit $\frac{5}{1920} = \frac{1}{384}$.

III. Reduce $\frac{1}{4}$ of a Farthing to the Fraction of a Guinea. Facit $\frac{1}{4032}$.

IV. Reduce $\frac{1}{7}$ of a dwt. to the Fraction of a lb. Troy? Facit $\frac{1}{1680} = \frac{1}{336}$.

V. Reduce the $\frac{4}{5}$ of an oz. to the Fraction of a cwt. *Avoir du Poids*? Facit $\frac{4}{8400} = \frac{1}{2100}$.

CASE XII. *To reduce a Fraction of an Integer to another Fraction of any Denomination of that Integer.*

RULE. Make the given Fraction into a Compound one, as in last Case, but, by descending from the greater to the less Denomination. Let the Denominator of the given Fraction stand for the Denominator of that required, and place for its Numerator the Product of the Numerator of the given Fraction multiplied by each Denominator, except its own, as in CASE X.

EXAMPLES.

I. Reduce $\frac{3}{800}$ of a £. Sterling to the Fraction of a Penny. Facit $\frac{3}{160}$.

$\frac{3}{800}$ of $\frac{1}{20}$ of $\frac{1}{12}$. Then, $3 \times 20 \times 12 = 720$, lowest Terms $\frac{1}{240}$.

II. Reduce $\frac{1}{384}$ of a £. Sterling to the Fraction of a Penny. Facit $\frac{5}{8}$.

III. Reduce $\frac{1}{4032}$ of a Guinea to the Fraction of a Farthing. Facit $\frac{1}{4}$.

IV. Reduce $\frac{1}{1680}$ of a lb. Troy to the Fraction of a dwt. Facit $\frac{1}{7}$.

V. Reduce $\frac{1}{2100}$ of a cwt. *Avoir du Poids* to the Fraction of an oz. Facit $\frac{1}{525}$.

CASE

CASE XIII. *To reduce any Denomination of an Integer to any Fraction of the Integer, or any other Denomination of the Integer.*

RULE. Reduce the Species into the last low mentioned Denomination, according to the Rules for Descending Reduction in Applicate Numbers, you'll have the Numerator. Reduce also, the Integer to the same Term, and you'll have the Denominator.

EXAMPLES.

I. What is the Fraction of 19s. 4d. to a £. Sterling? Facit $\frac{23}{20}$.
 $\frac{19s.}{12d. \text{ taking in the } 4d.}$ $\frac{£. 1}{20s.}$ $\frac{12d.}{12d.}$

232 Numerator. 240 Denominator.

Then, $\frac{232}{240}$ reduced = $\frac{29}{30}$

- II. What is the Fraction of 5s. to a £. Sterling? Facit $\frac{1}{20}$ or $\frac{1}{4}$.
 III. What is the Fraction of 5 $\frac{3}{4}$ d. $\frac{1}{2}$ to a Shilling? Facit $\frac{23}{60}$.
 IV. Reduce £. 4 - 6 - 8 to an Improper Fraction of a £. Sterling? Facit $\frac{13}{4}$.
 V. What is the Fraction of 8oz. 11dwts. 10 $\frac{2}{7}$ gr. to a lb. Troy? Facit $\frac{13}{16}$.
 VI. Reduce 11oz. 6 $\frac{6}{7}$ dr. to a lb. Avoir du Poids. Facit $\frac{1}{2}$.
 VII. Reduce 27 Gallons of Beer to the Fraction of a Barrel? Facit $\frac{3}{4}$.
 VIII. Reduce 243 Days 12 Hours to the Fraction of a Year, allowing 365 Days and 6 Hours to the Year? Facit $\frac{2}{3}$.
 IX. What is the Fraction of 18 Days 14 Hours 24 Minutes to a Month, allowing 31 Days to the Month? Facit $\frac{1}{4}$.

CASE XIV. *To find the Value of a Fraction in Money, Weight or Measure.*

RULE. Multiply the Numerator of the Fraction by the next lower Denomination of the Integer, as in Descending Reduction in Applicate Numbers, and divide by the Denominator. And, if any Thing remain, proceed as before continually till you have gone through all the known Parts the Integer may be divided into. The Quotients will quote the Answer.

N. B. When the Fraction is Improper; first, divide the Numerator by the Denominator; then, with the Remainder, work as above directed.

EXAMPLES.

I. What is the Value of $\frac{29}{30}$ of a £. Sterling? Facit 19s. 4d.

Numerator

ADDITION OF VULGAR FRACTIONS. 161

Numerator $29 \times 20s.$ in a $\text{£} = 580s. \div$ the Denominator $30 = 19s.$
and 10 over, which $\times 12d.$ in a $s. = 120d. \div$ the Denominator
 $30 = 4d.$

II. What is the Value of $\frac{1}{4}$ of a $\text{£}.$ Sterling? Facit $5s.$

III. What is the Value of $\frac{2}{6}$ of a Shilling? Facit $5 \frac{2}{3}d. \frac{1}{3}.$

IV. What is the Value of the Improper Fraction $\frac{13}{3}$ of a $\text{£}.$
Sterling? Facit $\text{£} 4 - 6 - 8.$

V. What is the Value of $\frac{1}{4}$ of a $lb.$ Troy? Facit $8oz. 11dwts.$
 $10 \frac{2}{3}gr.$

VI. What is the Value of $\frac{1}{4}$ of a $lb.$ *Avoir du Poids*? Facit
 $11oz. 6 \frac{1}{2}dr.$

VII. What is the Value of $\frac{3}{4}$ of a Barrel of Beer? Facit $27 Gallons.$

VIII. What is the Value of $\frac{2}{3}$ of a Year, allowing 365 Days
6 Hours to it? Facit $243 Days 12 Hours.$

IX. What is the Value of $\frac{3}{4}$ of a Month, allowing 31 Days to
it? Facit $18 Days 14 Hours 24 Minutes.$

ADDITION OF VULGAR FRACTIONS.

RULE. Reduce the given Fractions if they require it. Then, add all the Numerators together for a new Numerator, under which Total place the Denominator; if this new Fraction is improper, reduce it to a mixed Number; and if the Fraction is of Money, Weight and Measure, find its Value as in CASE XIV. of Reduction *.

EXAMPLES.

I. Add $\frac{1}{6}, \frac{4}{6}$ and $\frac{5}{6}$ together. Facit $\frac{10}{6}$ or $1 \frac{2}{3}.$

Here all the Denominators being alike, there is nothing else to do but to add all the Numerators together; thus, $1+4+5=\frac{10}{6}$, reduced, $1 \frac{2}{3}.$

II. Add $\frac{1}{4}, \frac{2}{4}$ and $\frac{5}{6}$ together. Facit $\frac{16}{12}$ or $1 \frac{1}{3}.$

Here the Denominators being not alike, the simple Fractions must be reduced to a common Denominator, according to CASE X. in Reduction, before you proceed to Addition.

III. Add $\frac{2}{3}$ of $\frac{1}{7} + \frac{1}{7}$ of $\frac{1}{6} + \frac{1}{6}$ of $\frac{1}{4}$ together. Facit $\frac{29}{84}$ or $\frac{2}{3} \frac{1}{4}.$

* If Reduction be well understood and remembered, the Addition and Subtraction of Fractions will be very easy; the Reason of which will be obvious, if we consider that the given Fractions being such, or reduced to such a State, that all the Numerators represent Things of the same Denomination, both absolute and relative; their Sum must therefore be a Number of such Parts as the common Denominator expresses of the same common Integer.

Y

These

These Fractions being compound, they must be reduced to simple Fractions, according to CASE VI. in Reduction, and the simple Fractions must be reduced to a common Denominator, as in CASE X. before you add.

IV. Add $5\frac{2}{3} + 6\frac{7}{8} + 4\frac{1}{2}$ together. Facit $17\frac{1}{24}$.

These being Mixed Numbers, reduce the Fractions to a common Denominator, then add the Numerators together, see how many Wholes there are in their Total, and add them to the other Whole Numbers.

V. Add $\frac{2}{3}$ of a £. Sterling to $\frac{3}{4}$ of a Shilling. Facit $\frac{33}{80}$ or 16s. 9d.

Find as in CASE XIII. of Reduction, what is the Fraction to a £. Sterling of $\frac{3}{4}$ of a Shilling, you'll find it to be $\frac{3}{80}$; then reduce $\frac{2}{3}$ and $\frac{3}{80}$ to a common Denominator, add the Numerators together; and to find the Value of the Total Fraction, work as in CASE XIV. of Reduction. Or else, find, according to said CASE XIV. the Value of each Fraction, then add.

VI. What is the Total of $\frac{3}{4}$ and $\frac{4}{7}$ of $\frac{1}{4} + \frac{3}{4}$ and $\frac{2}{3}$ of $\frac{1}{4}$ and $\frac{3}{8}$ of $\frac{1}{5}$? Facit $1\frac{759}{1120}$.

These being Mixed Fractions, wherein the Denominators are the Integral Parts, reduce them to simple Fractions according to CASE V. in Reduction. The simple Fractions reduce to a common Denominator, then proceed for Addition as before.

VII. Add $\frac{5}{4}$, $\frac{18}{24}$ and $\frac{4}{24}$ together. Facit $\frac{27}{24}$ or $1\frac{1}{8}$.

VIII. Add $\frac{3}{4}$ and $\frac{1}{2}$ together. Facit $\frac{11}{8}$ or $1\frac{1}{8}$.

IX. Add $\frac{2}{3}$ of a £. to $\frac{5}{8}$ ditto. Facit $\frac{31}{24}$ or £. 1 - 5 - 10.

X. Add $\frac{3}{5}$ of a £. to $\frac{2}{7}$ of a Shilling + $\frac{2}{3}$ of a Penny. Facit $1\frac{540180}{112000}$ or 7s. 1 $\frac{1}{2}$ d. $\frac{34}{5}$.

XI. Add $\frac{1}{4}$ of a Tun to $\frac{2}{3}$ of a lb. Avoir du Poids. Facit 14cwt. 1qr. 4lbs. 12oz. 12 $\frac{1}{2}$.

XII. Add $\frac{4}{5}$ of a Chaldron to $\frac{5}{6}$ of a Bushel. Facit 3qrs. 2bush. 2pec. 1gal. 6 $\frac{11}{15}$ Pints.

XIII. What is the Total of £. 346 - 17 - 9 $\frac{4}{5}$ + £. 1285 - 19 - 10 $\frac{3}{4}$ $\frac{2}{7}$ + £. 766 - 15 - 7 $\frac{1}{2}$ $\frac{2}{3}$? Facit £. 2399 - 15 - 3 $\frac{1}{2}$ + $\frac{239}{15}$ above $\frac{3}{4}$ of a Farthing.

SUBTRACTION OF VULGAR FRACTIONS.

RULE. Reduce the given Fractions as in Addition, if they require it. Then, if the Subtrahend be less than the Minuend, subtract the Numerator of the Subtrahend from the Numerator of the Minuend, and place the Remainder over the Denominator; but, if the Subtrahend be greater than the Minuend, subtract the Numerator of the Subtrahend from the Denominator, and to the Difference add the Numerator of the Minuend; then carry 1 to the Units of the Subtrahend Whole Number.

EXAMPLES.

I. From $\frac{12}{21}$ take $\frac{5}{21}$. Facit $\frac{7}{21}$ or $\frac{1}{3}$.
 Here, the Denominators being alike, you have nothing else to do but to subtract the Numerator 5 from the Numerator 12.

II. From $1\frac{1}{8}$ subtract $\frac{23}{8}$. Facit $\frac{1}{8}$.
 Here, reduce $1\frac{1}{8}$ into 24ths, then subtract the 23.

III. From $2\frac{3}{8}$ take $1\frac{7}{8}$. Facit $\frac{1}{4}$.
 Here, reduce $\frac{3}{8}$ and $\frac{7}{8}$ into a common Denominator, then subtract.

IV. From $\frac{29}{72}$ take $\frac{5}{8}$ of $\frac{1}{4}$. Facit $\frac{19}{72}$.
 Here, reduce the Compound Fraction into a simple one; then, this new Fraction and the $\frac{29}{72}$ to a common Denominator; afterwards subtract.

V. From $\frac{3}{4}$ and $\frac{2}{5}$ of $\frac{1}{4}$ and $\frac{3}{8}$ of $\frac{1}{5}$, take $\frac{3}{4}$ and $\frac{2}{5}$ of $\frac{1}{4}$. Facit $\frac{29}{120}$.
 Here, reduce the Mixed Fractions to simple Fractions, then subtract.

VI. From £. 1 $\frac{7}{4}$ take $\frac{5}{8}$ of a £. Facit 13s. 4d.
 Here, reduce $\frac{7}{4}$ and $\frac{5}{8}$ to a common Denominator, subtract; then, according to CASE XIV. of Reduction, find the Value of the remaining Fraction.

VII. From $\frac{10}{6}$ subtract $\frac{9}{6}$. Remain $\frac{1}{6}$.

VIII. From $1\frac{18}{24}$ take $\frac{23}{24}$. Facit $\frac{19}{24}$.

IX. From $\frac{3001}{4800}$ take $\frac{67}{800}$ of a £. Facit 6s. 8d.

X. From $\frac{14007}{19600}$ of a Tun subtract $\frac{2}{5}$ of a lb. Avoir du Poids. Facit 14cwt. 1qr. 4lbs.

XI. From $\frac{283}{80}$ of a Chaldron take $\frac{4}{5}$. Facit 3 Pecks $5\frac{1}{5}$ Pints.

XII. From £. 2399 - 15 - 3 $\frac{3}{4}$ $\frac{239}{112}$ take £. 2052 - 17 - 6 $\frac{1}{2}$ $\frac{111}{112}$. Facit £. 346 - 17 - 9 $\frac{1}{4}$ + $\frac{4800}{11823}$ or $\frac{4}{9}$.

XIII. What must be added to $31\frac{1}{2}$ and $14\frac{5}{8}$ to make up 60? Facit $13\frac{1}{16}$.

XIV. An Army having been defeated, $\frac{1}{10}$ were killed, $\frac{1}{5}$ were wounded, $\frac{1}{8}$ were made Prisoners, $\frac{1}{4}$ surrendered, and 14500, the Rest of the Army, made their Escape. What was the Whole of that Army? Facit 40000 Men.

First, Reduce the Fractions to the same Denominator, add them up together, and their Total subtract from the Denominator:

Thus, $\frac{1}{4} = \frac{4}{16}$ $\frac{1}{5} = \frac{3}{15}$ and $\frac{1}{8} = \frac{2}{16}$ Now, from . . 80 Minuend.
 $\frac{1}{8} = \frac{2}{16}$ Take . . 51 Subtrahend.
 $\frac{1}{16} = \frac{1}{16}$
 Remain . . $\frac{29}{80}$ Fraction of
 14500.

Then divide 14500 by 29 Numerator of the Remainder, the Quotient will quote the Value of 1 Part of the Integer; and that Quotient multiplied by all the Parts of the Integer, will give the Answer; thus,

$$14500 \div 29 = 500 \times 80 = 40000 \text{ Men.}$$

Y 2

MULTI

MULTIPLICATION OF VULGAR FRACTIONS.

RULE. Reduce the given Fractions to simple Expressions, if not so before (there is no need to reduce Compound Fractions); and to improper Fractions, if mixed Numbers. Then, multiply, as in CASE VI. of Reduction, the Numerators together for a new Numerator; and, multiply the Denominators likewise into one another for a new Denominator.

EXAMPLES.

I. What is the Product of $\frac{5}{6}$ multiplied by $\frac{3}{4}$? Facit $\frac{15}{24}$ or $\frac{5}{8}$.

Here, the Fractions being simple or proper, you have nothing else to do but to multiply the Numerators 5 and 3 into one another, to have the Numerator of the Product; then, to multiply the Denominators 6 and 4 likewise into one another, to have the Denominator of the Product.

N. B. One would, at first Sight, be much surpris'd that, in Multiplication of Fractions, the Product be less than the Multiplend: but, this Difficulty will soon vanish, if we consider the Nature of Whole Numbers and that of Fractions. Whole Numbers multiplied by more than Unity, increase; but, if they are multiplied by less than Unity, *i. e.* by Fractions, they decrease. Thus, if you multiply 1 by 2, or 2 by 1, you'll have the Product 2: it is as if, Fraction-ways, you had $\frac{1}{1}$ to multiply by $\frac{2}{1}$; where, according to the above given Rule, you would find the Product $\frac{2}{1}$ equal to 2 Integers: but if you multiply 1 by $\frac{1}{2}$, the Product will be $\frac{1}{2}$; and it is as if the Multiplend, Fraction-ways, was $\frac{2}{1}$ to be multiplied by $\frac{1}{2}$; where, also according to the above given Rule, you'll have the Product $\frac{2}{2} = \frac{1}{1}$.—Again, had you $\frac{1}{2}$ to multiply by $\frac{1}{2}$, it would produce only $\frac{1}{4}$; for 1 Yard, at 10s. or $\frac{1}{2}$ of a £. will only come to $\frac{1}{4}$ of a £. *viz.* 5s.—It is therefore evident, that $\frac{5}{6} \times \frac{3}{4}$ can produce no more than $\frac{15}{24} = \frac{5}{8}$.

II. What is the Product of $\frac{4}{5}$ of $\frac{1}{6}$ multiplied by $\frac{3}{4}$ of $\frac{7}{8}$? Facit $\frac{12}{80}$ or $\frac{3}{20}$.

Here, the Fractions being Compound, there is no need to reduce: but only to work as in the last Example.

III. What is the Product of $4\frac{7}{8}$ multiplied by $9\frac{3}{4}$? Facit $43\frac{7}{8}$.

Here, the Fractions being mixed, reduce them to simple Fractions; then, to get the Product, work as above directed.

IV. What is the Product of $35\frac{3}{4}$ multiplied by $26\frac{1}{2}$? Facit $929\frac{1}{2}$.

Here, having mixed Numbers, reduce them to improper Fractions; then, to get the Product, work as above directed.

V. Multiply $35 + \frac{3}{4}$ of $\frac{1}{6}$ by $14 + \frac{1}{2}$ of $\frac{1}{4}$. Facit $498\frac{59}{60}$.

Here,

Here, having Whole Numbers and compound Fractions; first, reduce the compound Fractions to simple Fractions; then, these simple Fractions and their respective Whole Numbers, reduce to improper Fractions; afterwards, work as above directed.

VI. What cost $\frac{3}{4}$ of an Ell of Cloth, at 15s. or $\frac{3}{4}$ of a £. per Ell? Facit 11s. 3d.

Here, after having multiplied the $\frac{3}{4}$ of an Ell by the $\frac{3}{4}$ of a £. reduce the Product to its Value according to CASE XIV. of Reduction.

VII. Multiply £. 3 - 6 - 8 by £. 3 - 6 - 8? Facit £. 11 - 2 - 2 $\frac{1}{2}$ $\frac{2}{3}$.

Fraction-ways, it is $3\frac{1}{3}$ by $3\frac{1}{3}$; which, after having reduced to improper Fractions, multiply as before directed; then, reduce the Product to its Value, according to CASE XIV. of Reduction.

VIII. Multiply 36 by $7\frac{2}{3}$. Facit 273 $\frac{2}{3}$.

When either the Multiplicand or the Multiplier is a Whole Number, the Product may be gotten without reducing the Whole Numbers into Fractions; but then, first, you must multiply the Numerator by the Whole Number; secondly, divide the Product of that Numerator by its Denominator, whose Quotient carry, and Remainder set down. Here, as 36 is equal to 6×6 , so, $7\frac{2}{3} \times 6 = 45\frac{2}{3} \times 6 = 273\frac{2}{3}$; which you may prove by working the Operation Fraction-ways.

IX. What is the Product of $\frac{5}{7}$ multiplied by $\frac{3}{4}$ of $\frac{1}{6}$? Facit $\frac{15}{168}$ or $\frac{5}{56}$.

X. What is the Product of $4\frac{5}{6}$ multiplied by $\frac{3}{4}$? Facit $7\frac{5}{8}$.

XI. Multiply 48 by $16\frac{5}{8}$. Facit 804.

XII. Multiply $25\frac{4}{5}$ by 6. Facit 152 $\frac{2}{5}$.

XIII. Multiply $4\frac{5}{6}$ by $3\frac{4}{5}$. Facit 16 $\frac{35}{30}$.

XIV. Multiply $34\frac{17}{24}$ by $36\frac{18}{24}$. Facit 1276 $\frac{61}{24}$.

XV. Multiply 34 by $2\frac{1}{4}$ of $\frac{1}{4}$. Facit 70 $\frac{1}{4}$.

XVI. What is the Value of $\frac{5}{6}$ of a Yard, at $\frac{7}{8}$ of a Shilling? Facit 7d. + $\frac{1}{7}$.

XVII. Bought 348 $\frac{11}{12}$ Pieces of Cloth, at £. 16 - 16 - 4 per Piece. Facit £. 2378 - 8 - 11 $\frac{2}{3}$.

XVIII. Multiply $458\frac{17}{24}$ by £. 8 - 6 - 8 $\frac{1}{2}$. Facit £. 3823 - 7 - 9 $\frac{1}{4}$ $\frac{1}{2}$.

XIX. What Number divided by $\frac{3}{7}$ will give $26\frac{46}{77}$? Facit 11 $\frac{2}{7}$.

DIVISION OF VULGAR FRACTIONS.

RULE. Prepare the Fractions, as in Multiplication; then, if both Denominators are alike, the Numerator of the Dividend is the Numerator of the Quotient, and the Numerator of the Divisor, will be the Denominator thereto; but, if the Denominators are not alike, multiply, as in CASE X. of Reduction, the Numerator of

of the Dividend by the Denominator of the Divisor, for a new Numerator, and the Numerator of the Divisor by the Denominator of the Dividend, for a new Denominator.

EXAMPLES.

I. Divide $\frac{5}{8}$ by $\frac{3}{4}$. Facit $\frac{30}{4}$ or $\frac{5}{6}$ *.

5, Numerator of the Dividend $\times$ 4, Denominator of the Divisor = 20

3, Numerator of the Divisor $\times$ 8, Denominator of the Dividend = 24

II. Divide $\frac{1}{10}$ by $\frac{3}{4}$ of $\frac{1}{7}$. Facit $\frac{28}{10}$ or $\frac{2}{15} = \frac{2}{3}$ of $\frac{1}{6}$.

Here, reduce the compound Fraction to a simple Fraction; then, work as before.

III. Divide $\frac{437}{2520}$ by $2\frac{3}{8}$. Facit $\frac{31464}{47580}$ or $\frac{23}{35} = 4\frac{7}{35}$.

Here, reduce the mixed Fraction to a simple Fraction; then, work as before.

IV. Divide $929\frac{1}{2}$ by $35\frac{3}{4}$. Facit 26.

Here, reduce the mixed Numbers to improper Fractions; then, work as before.

V. Divide $152\frac{2}{3}$ by 6. Facit $25\frac{4}{9}$.

Here, the Divisor being a Whole Number, you may obtain the Quotient without reducing the Whole Numbers into Fractions; thus, $152\frac{2}{3} \div 6 = 25\frac{1}{3} + \frac{2}{9}$ of $\frac{1}{3}$ or $25\frac{4}{9}$, which you may prove by working the Operation Fraction-ways.

VI. Divide 804 by $16\frac{3}{4}$. Facit 48.

Here, express the Whole Number Fraction-ways, and the mixed Number into an improper Fraction; then, work as before.

VII. Divide $273\frac{1}{2}$ by $7\frac{1}{2}$. Facit 36.

Here, the Denominators being, in both Factors, alike; after having reduced the Mixed Number into improper Fractions, there is nothing else to do but to divide the Numerator of the Dividend by the Numerator of the Divisor.

VIII. Bought for 11s. 3d. Cloth, at $\frac{3}{4}$ of a lb. per Ell; How much Cloth did I buy? Facit $\frac{1}{2}$ of an Ell.

$\frac{11}{20} = \frac{11}{20} \div \frac{3}{4} = \frac{44}{60}$ or $\frac{11}{15}$.

IX. If $\frac{5}{6}$ of a Yard cost $7\frac{1}{2}$ d. What is it per Yard? Facit $8\frac{1}{2}$ d.

$7\frac{1}{2} = \frac{15}{2} \div \frac{5}{6} = \frac{45}{5} = 9$ or $\frac{60}{7}$ of a Penny, which, according to CASE

XIV. of Reduction, will be found = $8\frac{1}{2}$ d. or $\frac{1}{2}$ of a Shilling.

* Division being the Reverse of Multiplication; observe that, when any Whole Number is divided by a simple Fraction, the Quotient will be so much larger than the Dividend, as the Divisor is less than Unity, or 1; but, on the contrary, when a simple Fraction is divided by a Whole Number, then the Quotient will be so much less than the Dividend, as the Divisor exceeds Unity.

X. What

THE RULE OF THREE IN VULGAR FRACTIONS. 167

X. What Sum multiplying £. 3 - 6 - 8, will give £. 11 - 2 - 2 $\frac{1}{2}$ $\frac{2}{3}$?
Facit £. 3 - 6 - 8.

£. 11 - 2 - 2 $\frac{1}{2}$ $\frac{2}{3}$ reduced, according to CASE XIII. will give $\frac{32000}{23880}$
or $\frac{100}{76}$; which divided by $\frac{10}{3}$, Fraction of £. 3 - 6 - 8, will give
 $\frac{300}{90}$ or $\frac{10}{3}$ = £. 3 - 6 - 8.

XI. Bought 348 $\frac{11}{12}$ Pieces of Cloth, which cost me in all
£. 2378 - 8 - 11 $\frac{2}{3}$; How much is it per Piece? Facit £. 6 - 16 - 4.
Such a Question may be worked as the others have been; or, first, by re-
ducing the Divisor into an improper Fraction; secondly, by dividing
the given Dividend by the Numerator, according to CASE III. in
Division of Applicate Numbers; thirdly, by multiplying the Quotient
by the Denominator of the Divisor.

XII. Divide $\frac{5}{36}$ by $\frac{3}{4}$ of $\frac{1}{6}$. Facit $\frac{5}{72}$.

XIII. Divide $\frac{20}{40}$ by $4 \frac{5}{6}$. Facit $\frac{3}{8}$.

XIV. Divide $16 \frac{33}{4}$ by $4 \frac{5}{6}$. Facit $3 \frac{4}{5}$.

XV. Divide $1276 \frac{61}{2}$ by $34 \frac{17}{4}$. Facit $36 \frac{18}{3}$.

XVI. Divide $70 \frac{1}{4}$ by $2 \frac{1}{4}$ of $\frac{1}{4}$. Facit 34.

XVII. What Number multiplying $26 \frac{4}{5}$, will give 11 $\frac{9}{17}$? Facit $\frac{7}{17}$.

XVIII. What Number multiplied by £. 8 - 6 - 8 $\frac{3}{4}$, will give
£. 3823 - 7 - 9 $\frac{43}{163}$? Facit $458 \frac{17}{4}$.

THE RULE OF THREE IN VULGAR FRACTIONS.

RULE. If any of your Terms be Integers, mixt or compound
Fractions, they must be reduced, as before directed. Then, stating
your Question, as in the Rule of Three of Integers, and multiplying
and dividing, as in Multiplication and Division of Vulgar Fractions,
your Work is finished, and the Quotient quotes the Answer.

If either of the Extrems be a Fraction and the other an Integer,
reduce the Integer to the Denomination of the Fraction; then,
cancel the Denominators, and work as in Integers.

EXAMPLES.

I. If $\frac{3}{4}$ of a Yard cost $\frac{5}{8}$ of a £. what will $\frac{9}{10}$ of a Yard come to?
Facit $\frac{3}{4}$ of a £. or 15s.

As $\frac{3}{4}$: $\frac{5}{8}$ of a £. :: $\frac{9}{10}$ } The third Term $\frac{9}{10}$ requiring an
 $\frac{5}{8} \times \frac{9}{10} = \frac{45}{80}$ } Answer greater than the middle
and, $\frac{45}{80} \div \frac{3}{4} = \frac{15}{20}$ or $\frac{3}{4}$ of a £. } Term; that middle Term $\frac{5}{8}$
Now, $3 \times 20s. = 60s. \div 4 = 15s.$ } of a £. must be multiplied by
the greater Extream $\frac{9}{10}$, and di-
vided by the less Extream $\frac{3}{4}$.

II. What Quantity of a Stuff that is $\frac{3}{4}$ Yard Wide, will line 7 $\frac{1}{2}$
Yards of Cloth, which is $\frac{6}{4}$ or 1 $\frac{1}{2}$ Yard wide? Facit 15 Yards.

As

As $\frac{6}{4} : \frac{15}{2} :: \frac{3}{4}$ } The third Term $\frac{3}{4}$ requiring an Answer
 $\frac{6}{4} \times \frac{15}{2} = \frac{90}{8}$ } greater than the middle Term;
 and, $\frac{90}{8} \div \frac{3}{4} = \frac{360}{24}$ or 15 } that middle Term $\frac{15}{2}$ must again be
 multiplied by the greater Extream $\frac{6}{4}$,
 and divided by the less Extream $\frac{3}{4}$.

III. If $\frac{3}{4}$ of a lb. of Flax cost 8d. What will 1lb. cost? Facit $10\frac{1}{2}d. + \frac{2}{3}$.

As $\frac{3}{4} : \frac{8}{1}d. :: \frac{4}{1}$:
 $\frac{3}{4} \times \frac{4}{1} = \frac{32}{4}$
 and, $\frac{32}{4} \div \frac{3}{4} = \frac{128}{3} = 10\frac{1}{2} + \frac{2}{3}$

Or, canceling the Denominators.

As 3 : 8d. :: 4

or 1 : 8 :: 1 + $\frac{1}{3}$

So add $\frac{1}{3} = 2\frac{1}{3}$

10 $\frac{1}{2} \frac{2}{3}$

IV. What is the Interest of £. 219 - 13 - 4 for one Year, at $5\frac{3}{8}$ per Cent. ? Facit £. 11 - 16 - $1\frac{1}{2} + \frac{2}{3}$.

As $\frac{100}{1} : 5\frac{3}{8} :: 219\frac{2}{3} : -$ But, because the mixed Numbers must be reduced, it will be as $\frac{100}{1} : 4\frac{3}{8} :: 6\frac{5}{9} : -$ Then, $4\frac{3}{8} \times 6\frac{5}{9} = \frac{28337}{2400}$ valued to £. 11 - 16 - $1\frac{1}{2} + \frac{2}{3}$ of a Farthing.

V. If $\frac{1}{4}$ of Muslin cost 3s. What will $\frac{11}{16}$ cost? Facit 8s. 3d.

VI. If $\frac{6}{7}$ are worth £. 9, What will $\frac{11}{17}$ be worth? Facit £. 4 - 15 - 5 $\frac{1}{17}$.



OF DECIMAL FRACTIONS.

In *Decimal Fractions*, the Whole is supposed to be divided into ten equal Parts, each of these Parts into ten other equal Parts, and each of these into ten other Parts, and so on *ad infinitum*.

A *Decimal Fraction*, is distinguished from an Integer by a Comma or a Dot prefixed to it, whose Denominator, though not expressed, is known by the Distance of the first Figure to the Right-Hand, from the Comma or Dot counted as 1. Thus, .6 is expressed or signifies $\frac{6}{10}$.—.15 signifies $\frac{15}{100}$.—.06 is as $\frac{6}{100}$.—.006 as $\frac{6}{1000}$.—Again, 4.36 signifies $4\frac{36}{100}$.—5.003 is as $5\frac{3}{1000}$, &c.

Hence, it is evident, that, in a Series of Decimal Parts, the Decrease will be in the same Proportion as the Increase in a Series of Whole Numbers; and that, Cyphers before Figures of Decimal Parts decrease their Value in the same Proportion as the Figures would be increased by the same Number of Cyphers annexed, if they were considered as Whole Numbers. But, Cyphers after Decimal Parts do not alter their Value; for .6, .60, .600, .6000, &c. are each but $\frac{6}{10}$ of an Integer.

REDUCTION

REDUCTION IN DECIMAL FRACTIONS.

CASE I. To reduce Vulgar Fractions to Decimal Fractions.

RULE. Make the Denominator Divisor of the Numerator, annexing Cyphers, or supposing Cyphers annexed, to that Numerator or its Remainders continually, till it remains nothing in the Dividend, or till a Figure or several Figures in the Quotient are repeated. The Quotient will be the Decimal Fraction required.

Note I. If the given Vulgar Fraction can be brought to lower Terms, it is well to do it before you reduce the Fraction to Decimals.

II. When you have 5 Places in the Decimals, it is sufficient; for the Remainder will be too minute to cause any sensible Error.

III. If in the Division there be continually a Remainder, and the Quotient repeat the same Figure, it is unnecessary to carry on the Division farther.

The Repetend may be simple or compound.—It is simple, when it repeats always the same Figure.—It is compound, when it repeats always several Figures. Thus, .1666 is a simple recurring Decimal, and 725725 is a compound recurring Decimal.

A single Repetend may be marked or distinguished with a Dot above it; and a Compound with a Dot above the first and last Figures of the Circulation.

IV. If the repeated Figure happen to be 9, suppress it and add 1 to the preceding Figure of the Quotient. Thus, for .34999, &c. or .349, write .35.

EXAMPLES.

I. Reduce $\frac{3}{4}$ to a Decimal. Facit .75.

$$\begin{array}{r} 4 \overline{) 30.0} \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

To the Numerator 3 I annex 0, and then it is 30; which, divided by 4, give the Quotient 7, and 2 over. So, as there are 2 over, I annex another 0; thus, I have 20 (for new Dividend) which, divided again by 4, give 5, and nothing over. Now, as there is nothing over, I annex no more Cyphers, but conclude that .75 is the Decimal of $\frac{3}{4}$; which is evident, since $\frac{3}{4}$ of 100 = 75.

II. Reduce $\frac{1}{2}$ of $\frac{3}{4}$ to a Decimal. Facit .625.

$\frac{1}{2}$ of $\frac{3}{4} = \frac{3}{8}$ reduced to lower Terms $\frac{3}{8}$, So, 8) 30.000

$$\begin{array}{r} 8 \overline{) 30.000} \\ \underline{24} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

III. Reduce

III. Reduce $\frac{1}{80}$ to a Decimal. Facit .0125.

80) 10.0 (.0125 Or, contracting the 0 in the Divisor, and the first
20.0 to be annexed to the Dividend; thus,

$$\begin{array}{r} 40.0 \\ 80 \overline{) 10.0} \\ \underline{80} \\ 20.0 \\ \underline{160} \\ 40.0 \\ \underline{400} \\ 00 \end{array}$$

1.0
2.0

IV. Reduce $\frac{1}{6}$ to a Decimal. Facit .16.

$$6) 10.0000$$

.1666 *ad Infinitum*. Simple recurring Decimal.

V. Reduce $\frac{1}{7}$ to a Decimal. Facit .142857.

37) 50 (135135, &c. Compound recurring Decimal.

$$13.0$$

$$19.0$$

$$5.0$$

$$13.0$$

$$19.0$$

$$5$$

VI. Reduce $\frac{1}{20}$ to a Decimal. Facit .05.

VII. Reduce $\frac{1}{25}$ to a Decimal. Facit .04.

VIII. Reduce $\frac{1}{40}$ to a Decimal. Facit .025.

IX. Reduce $\frac{1}{5}$ to a Decimal. Facit .2.

X. Reduce $\frac{1}{10}$ to a Decimal. Facit .1.

XI. Reduce $\frac{1}{2}$ to a Decimal. Facit .5.

XII. Reduce $\frac{1}{3}$ to a Decimal. Facit .3333.

XIII. Reduce $\frac{1}{11}$ to a Decimal. Facit .0909.

XIV. Reduce $\frac{1}{16}$ to a Decimal. Facit .0625.

CASE II. To reduce any of the known Parts of a Whole Number to a Decimal Fraction.

RULE. Bring the given lowest Denomination, into a Decimal Fraction of the next given superior Denomination. To the Decimals, prefix the given Parts of the next given superior Denomination, and divide again by such a Number of that as is equal to an Unit of the next Superior. Thus, proceed till you bring out the Decimal Parts of the highest Integer.—When a single low Denomination is given to be brought to the Decimal of a mentioned high Denomination, divide that single Denomination by the Number of Parts (of that low Denomination) contained in the mentioned high Denomination. The Quotient will quote the Decimal.

N. B. 1st, in reducing to Decimals it is unnecessary to mind the Cyphers on the Right-Hand of the Divisor, as Cyphers must be annexed to the Remainder to bring out the Quotient.

adly,

2dly, When, in Division, the Quotient is repeated, the next Division is carried on, not by Cyphers, but by the Repetend, till the Quotient ends with a Repetend.

EXAMPLES.

I. Reduce 7s. 6d. to the Decimal of a £. Facit .375.

$$\begin{array}{r} 6d. \text{ being } \frac{6}{12} \text{ of a Shilling } 12) 60 \\ 2) 7.5 \\ .375 \end{array}$$

Here, according to the Rule, I add a Cypher to the lowest Denomination 6d. and divide by 12. Then, to the Quotient 5, I prefix the 7s. and divide by 2 for 20, without cutting off any Figure to the Right, for there is no Occasion for it.

II. Reduce 14s. 6 $\frac{3}{4}$ d. to the Decimal of a £. Facit .728125.

$$\begin{array}{r} 4) 30.0 \\ 12) 6.75 \\ 2) 14.5625 \\ .728125 \end{array}$$

III. Reduce 10s. 8 $\frac{1}{2}$ d. to the Decimal of a £. Facit .53472.

$$\begin{array}{r} 3) 10 \\ 12) 8.3 \\ 2) 106944 \\ .53472 \end{array}$$

Here, as the first Decimal ended with a Repetend, instead of supposing Cyphers annexed, I have supposed Repetends.

IV. What is the Decimal of 50z. to a lb. Troy-Weight? Facit .416.

$$\begin{array}{r} 12) 50 \\ 416 \end{array}$$

As there are 12oz. in a lb. Troy-Weight; so, I divide by 12.
ad Infinitum.

V. What is the Decimal of 7dwts. to a lb. Troy-Weight?

Facit .02916.

$$\begin{array}{r} 24) 7 \\ 7.0 \\ 22.0 \\ 4.0 \\ 16.0 \\ 16 \\ 16 \end{array}$$

(.02916 ad Infinitum, There being 240dwts. to a lb. Troy-Weight, I divide by 240; or by 24, canceling 0 on both sides.

VI. What is the Decimal of 110z. 18dwts. 20gr. to a lb. Troy-Weight? Facit .995138.

$$\begin{array}{r} 24) 20.0 \quad (83 \\ 8.0 \\ 8 \end{array} \quad \begin{array}{r} 2) 18.83 \\ 12) 11.9416 \\ .995138 \end{array}$$

172 REDUCTION IN DECIMAL FRACTIONS.

The above Operation is worked in the same Manner as the third Example. It may likewise be worked by reducing 11oz. 18dwts. 20gr. to Grains, which will be found = 5732, and dividing by 5760 Grains in a lb. Troy.

VII. Reduce 19cwt. 3qrs. 14lbs. Avoir du Poids, to the Decimal of a Tun? Facit .99375.

28) 140 (5
00

4) 3.5

2) 19.875

.99375

VIII. Reduce 6s. 6d. to a Decimal of a £. Facit .325.

IX. Reduce 8s. 4d. to the Decimal of a £. Facit .416.

X. What is the Decimal of 8 Grains Troy-Weight to a lb.? Facit .00138.

XI. Reduce 14cwt. to the Decimal of a Tun? Facit .7.

XII. Reduce 17cwt. to the Decimal of a Tun. Facit .85.

From the two last Examples it may be observed that, when 20 is the Divisor, the Half of the Dividend will be the Decimal, if that Dividend is even; and when odd, 5 are to be added to the Half of the Dividend less 1.

XIII. Reduce $\frac{3}{4}$ of a cwt. to the Decimal of a cwt. Facit .75.

XIV. Reduce 13lbs. to the Decimal of a cwt. Facit .11607 +

XV. Reduce 2qrs. 14lbs. 3oz. 4dr. to the Decimal of a cwt. Facit .62681 +

XVI. Reduce 14oz. to the Decimal of a lb. Avoir du Poids. Facit .875.

XVII. Reduce 8 Drams to the Decimal of a lb. Facit .03125.

XVIII. Reduce 16s. to the Decimal of a £. Facit .8.

XIX. Reduce 3s. to the Decimal of a £. Facit .15.

XX. What is the Decimal of 3 Farthings, or $\frac{3}{8}$ to a £.? Facit .003125.

NOTE. To nearly get the Decimal of Shillings, Pence and Farthings, by Inspection only, and in 3 Figures.

RULE. Reduce the Pence into Farthings, taking in the given Farthings if any. If their Sum be 25, or less than 25, add 1 more to their Number: If they are above 25, add 2 more to their Number; and the Total join to the Half of Shillings. Observe likewise, that if the Shillings are odd, the Farthings found as above, must be increased by 50 for the Shilling over the Half.

EXAMPLES.

XXI. What is the Decimal of 14s. 4 $\frac{1}{4}$ d.? Facit .718.

4 $\frac{1}{4}$ d. being equal to 17 Farthings, I consider them as 18, prefix to the 18, the Half of the 14s. and thus, I have .718 Decimal required.

XXII. What

- XXII. What is the Decimal of 16s. 7 $\frac{1}{2}$ d. ? Facit .833.
Here, as 7 $\frac{1}{2}$ d. = 31 Farthings, I set down 33, to which I prefix 8 for the Half of 16s.
- XXIII. What is the Decimal of 15s. 6 $\frac{3}{4}$ d. ? Facit .779.
Here, 6 $\frac{3}{4}$ d. being equal to 27, according to the Rule it is 29 to set down; but because the Shillings are odd, I must for 1s. increase them by 50, and therefore make them 79; to which, prefixing 7 for the Half of the other 14s. I have the Decimal required .779.
- XXIV. What is the Decimal of 6s. 10 $\frac{1}{2}$ d. ? Facit .344.
Here, 10 $\frac{1}{2}$ d. being equal to 42 Farthings, I must add 2 more, and thus make them 44; to which, prefixing 3 for the Half of 6s. the Decimal is .344.
- XXV. What is the Decimal of 6s. 6d. ? Facit .325.
 XXVI. What is the Decimal of 17s. 6 $\frac{3}{4}$ d. ? Facit .879.
 XXVII. What is the Decimal of 11s. 10 $\frac{3}{4}$ d. ? Facit .595.
 XXVIII. What is the Decimal of 16s. 8d. ? Facit .834.

CASE III. To Value any Decimal Fraction into the known Parts of an Integer.

RULE. If the Decimal is finite, multiply the given Decimal by as many of the next inferior Denomination as make one of the Integer; and point off a Number of Places from the Right-Hand of the Product, equal to those in the given Decimal; which will be a new Decimal, to be multiplied by as many of the next inferior Denomination as make one of the former: thus, proceed till the Decimal Places become Cyphers, or no Denomination be left for a Multiplier; and the Figures to the Left-Hand of each Point will quote the Value required.

If the Decimal terminates in a Repetend, work as aforesaid; but observe, to add 1 for every 9 in each Product of the first Figure of the Multiplication, and if the Multiplier consists of several Digits or Figures, make the Products conterminous before Addition; where, add 1 likewise for every 9 of the first Row, as the significant Figures in that Row, coming from Repetends, are always Repetends. If the Repetend is alone, that is, not preceded by other Decimal Figures, let it be repeated three Times, so that the Decimal consist of three Places.

N. B. 1st, In multiplying, the Cyphers to the Right need not be noted; but they must be remembered, in pointing the Product so many Places less, as there have been Cyphers canceled.

2dly, When the Multiplicand terminates in a Repetend, and the Multiplier in a Cypher, dont mind the Cypher; but observe, that the first Figure which has been put down in the Product must be repeated, and put in the Place of the Cypher canceled.

Remember,

Remember, that .5 signifies and is the Half of any Whole or Thing; .25 is the one Quarter, .75 is the three Quarters; .3 is the one Third, and .6 is the two Thirds, &c. as 5 is the Half of 10; 25 the $\frac{1}{4}$ of 100; and 75 the $\frac{3}{4}$ of 100, &c.

EXAMPLES.

I. What is the Value of .728125 of a £.? Facit 14s. 6 $\frac{3}{4}$ d.

2 I multiply by 2 (instead of doing it by 20) canceling the 0; but then in the Product, I point off after the fifth Figure, instead of the sixth.

14.56250

12

6.7500

4

3.00

I don't mind the 0 in the Multiplicand.

II. What is the Value of .416 of a £.? Facit 8s. 4d.

2 Since I cancel the 0 in 20s. I must point off two Places only in the Product; and because 6 is a Repetend, so I must add 1 for the 9 in 12.

8.33

12

4.00

Taking in 4 for the Nines in 36, because 3 is a Repetend.

III. What is the Value of .6 of a Tun? Facit 13cwt. 1qr. 9 $\frac{1}{2}$ lbs.

The Decimal being a Repetend and not preceded by any other Figure, it must be repeated three Times; thus,

.666

2 canceling the 0 in 20cwt. which = a Tun.

13.33

4 Quarters in a cwt.

1.33

28

266

666 Here, I repeat 6 to make the Figures continuous, before Addition.

9.33

IV. What

IV. What is the Value of $.8\bar{3}$ of a *lb.* Troy? Facit 10oz.

$.8\bar{3}$

12oz. in a *lb.*

10.00

V. What is the Value of $.8\bar{3}$ of a *£.*? Facit 16s. 8d.

VI. What is the Value of .93958 of a *£.*? Facit 18s. 9d. $\frac{1}{2}$ nearly $\frac{1}{2}$.

VII. What is the Value of .416 of a *lb.* Troy? Facit 5oz.

VIII. What is the Value of .02916 of a *lb.* Troy? Facit 7dwts.

IX. What is the Value of .995138 of a *lb.* Troy? Facit 11oz. 18dwts. 20gr.

X. What is the Value of .99375 of a Tun? Facit 19c. 3qr. 14lbs.

XI. What is the Value of .62681 of a cwt.? Facit 2qrs. 14lbs. 3oz. and nearly 4dr.

NOTE. To nearly get the Value of any three Places of Decimals, in Shillings, Pence and Farthings, by Inspection only.

RULE. Double the Figure next to the Point, and if the next Figure be under 5, then the Product of that Double will be Shillings; but, if the second Figure be 5 or above, then you must join 1s. more to those you got by the Double. Afterwards observe, that what remains from the second Figure above 5, prefixed to the third Figure, will make Farthings; but observe likewise, that if the Number of Farthings be 25 or under 25, you must take 1 off; and, if their Number be 26 or above, you must take off 2.

EXAMPLES.

XII. What is the Value of .718 of a *£.*? Facit 14s. 4 $\frac{1}{4}$ d.

The Double of the first Figure = 14s. Now, 18, considered as 17 Farthings, remain, which are equal to 4 $\frac{1}{4}$ d. for $17 \div 4 = 4 + \frac{1}{4}$.

XIII. What is the Value of .375 of a *£.*? Facit 7s. 6d.

Here, the Double of the first Figure 3 = 6s. but, as the next Figure is 7, so, according to the Rule, for 5 in the second Place I must add 1 more to the 6s. Thus, I have 7s. for 350, and 25 remain, which (being decreased of 1, because the Number is 25) are to be considered as 24 Farthings only = 6d. since $24 \div 4 = 6$.

XIV. What is the Value of .003125 of a *£.*? Facit 3 Farthings.

Here, the two first Decimal Places being Cyphers, the third must be as many Farthings as it expresses Unity; and, that third Figure being a 3, its Value must be 3 Farthings.

XV. What is the Value of .0772 of a *£.*? Facit 1s. 6 $\frac{1}{4}$ d.

Here, the first Decimal Place being a Cypher, there would be no Shilling if the second did not contain one 5; but, since the second Figure is a

7, for 5 I write down 18, and then it remains 2, which, with the third Figure, makes 27, to be considered only, according to the Rule, as 25 Farthings = $6\frac{1}{4}d$.

XVI. What is the Value of .93958 of a £.? Facit 18s. $9\frac{1}{4}d$.

XVII. What is the Value of .779 of a £.? Facit 15s. $6\frac{3}{4}d$.

XVIII. What is the Value of .39525 of a £.? Facit 7s. $10\frac{3}{4}d$.

XIX. What is the Value of .83 of a £.? Facit 16s. $7\frac{3}{4}d$.

Here, you must set down the Repetend once more, and consider the given

Decimals as .833.

ADDITION IN DECIMAL FRACTIONS.

RULE. Place the given Numbers, whether pure Decimals or mixed Numbers, successively under one another, in such a Manner, that the several Points be under one another in one Row, Tens under Tens, Hundreds under Hundreds, Thousands under Thousands, &c. then, add them as Whole Numbers. But observe, that when any of the Decimals is a Repetend, you must make the Repetend continuous, and add it to the Total of the first Right-Hand Row for every 9 which is contained in it.

EXAMPLES.

I. Add $7.245 + 46.234 + .00125 + 32.43$ together. Facit 79.38975.

7.245

46.234

.00125

32.43

79.38975

II. Add £.34 - 7 - $7\frac{1}{4}$ + £.56 - 17 - 5 + £.36 - 13 - 4 + £.24 - 6 - 8 + £.15 - 13 - 4, Decimally, and find the Value of the Total. Facit 167.9197916 = £.167 - 18 - $4\frac{1}{4}$.

£.34 - 7 - $7\frac{1}{4}$ = 34.3822916

56 - 17 - 5 = 56.8708333

36 - 13 - 4 = 36.6666666

24 - 6 - 8 = 24.3333333

15 - 13 - 4 = 15.6666666

Here, according to the Rule, I set down the Repetends 3, 6, 3 and 6 as often as there are Plates in the first Decimal.

Total 167 - 18 - $4\frac{1}{4}$ = 167.9197916 } joining 2 for the 2 Nines which are in 24.

Or,

Or, according to the Notes in CASE II. and III. thus,

£. 34 - 7 - 7 $\frac{3}{4}$	= 34.383	} I do not take in 1 for the 16 Farthings in 4d. because, in this Rule, if I take in 1 or 2 for the great Numbers of Farthings, I must observe that (upon an Average) I am to add nothing to those that are under 20.
56 - 17 - 5	= 56.871	
36 - 13 - 4	= 36.666	
24 - 6 - 8	= 24.334	
15 - 13 - 4	= 15.666	
167 - 18 - 4 $\frac{3}{4}$	= 167.920	

III. Add 30.07 + 2.0071 + 59.4 + 3207.1. Facit 3298.5771

IV. Add 27.5 - 52 + 3.2075 + .5741 + 2720. Facit 2803.2816.

V. Find decimally the Total of $475\frac{3}{4} + 397\frac{1}{8} + 475\frac{1}{2} + 99\frac{3}{8} + 8\frac{3}{8}$. Facit 1456.3333 = 1456 $\frac{1}{3}$.

NOTE. If your Numbers, given to be added, are not all of the same Denomination, they must be brought into Fractions of the like Denomination, by dividing the low Denomination, by such a Number of Parts of that low Denomination as equal one of the higher; thus, for Instance: let it be required to add .725 of a £. to .625 of a s. First, bring the Decimal of a s. .625 into a Decimal of a £. thus, 20) .625; or thus, 2) .0625 by prefixing a

Cypher to .625, and dividing by 2 canceling the 0 in 20. Then add as follows:

	.725
	.03125
Total required - - -	.75625

SUBTRACTION IN DECIMAL FRACTIONS.

RULE. Place your Minuend and Subtrahend, as in Addition, and work as in Whole Numbers. But, observe first, that if the Decimal Parts in either Number have fewer Places than the other, the Vacancy must be supplied by either annexing so many Cyphers if the Decimal is finite, and so many Repetends if the Decimal terminates in a Repetend, or supposing them to be annexed. 2dly, That when they terminate in a Repetend, and the Minuend is less than the Subtrahend, you are to join 9, instead of 10, to the first repeating Place of the Minuend, and carry 1.

A 2

EXAMPLES.

178 MULTIPLICATION IN DECIMAL FRACTIONS.

EXAMPLES.

I. From 270.2 subtract 75.4075. Facit 194.7925.

$$\begin{array}{r} 270.2 \\ 75.4075 \\ \hline \end{array}$$

Here, I suppose 3 Cyphers in the Minuend to supply the three Places which are vacant.

Remains 194.7925

II. Subtract decimally £. 18 - 11 - 9 from £. 54 - 19 - 6. Facit 36.3875, or £. 36 - 7 - 9.

$$\begin{array}{r} £. 54 - 19 - 6 \\ 18 - 11 - 9 \\ \hline \end{array} = \begin{array}{r} 54.975 \\ 18.5875 \\ \hline \end{array}$$

Remains . . . 36 - 7 - 9 = 36.3875

III. Subtract decimally £. 69 - 6 - 8 from £. 35 - 13 - 4. Facit 33.6, or £. 33 - 13 - 4.

$$\begin{array}{r} £. 69 - 6 - 8 \\ 35 - 13 - 4 \\ \hline \end{array} = \begin{array}{r} 69.3 \\ 35.6 \\ \hline \end{array}$$

Here, because the Decimals are Repetends, and the Minuend is less than the Subtrahend, I join 9 to 3; then, it is 6 to be subtracted from 12.

IV. From £. 17 - 11 - 7 = 17.57916 Subtract . . £. 14 - 16 - 8 = 14.83

$$2 - 14 - 11 = 2.74583$$

Here, I suppose the Repetend 3 continuous to the last Decimal Place 6.

V. From 5.25 take .98407. Facit 4.26593.

VI. Borrowed 100 Guineas or £. 105, and paid at three several Times each £. 27 - 5 - 6; find decimally, What remains to pay. Facit £. 23.175, or £. 23 - 3 - 6.

NOTE. If your Numbers, given to be subtracted, are not of the same Denomination, you must, as in Addition, bring them into one Denomination. As for Instance: was it required to subtract .03125 of an oz. Troy, from .0625 of a lb. Troy, you must divide .03125 Decimal of an oz. by 12, since there are 12 oz. in a lb. and you'll have .002604, which being subtracted from .0625 will give the Remainder .059896 = 14 drs. 8 gr.

MULTIPLICATION IN DECIMAL FRACTIONS.

RULE. Multiply as if both the Multiplier and the Multiplicand were Whole Numbers, having no Regard to the Decimals till the Work is done. Count how many Decimal Places there are in both the Multiplier and the Multiplicand, and point off as many Places in the Product.

MULTIPLICATION IN DECIMAL FRACTIONS. 179

If the Whole Product does not give as many Places as there are in both Factors, then you must supply that Defect by prefixing a Cypher, or Cyphers.

If the Multiplicand terminate in a Repetend, multiply as usual: but, observe, to add, as in CASE III. of Reduction, 1 for every 9 in each Product of the first Figure of the Multiplication, making the Products conterminous before Addition, if the Multiplier consists of several Figures.

If it is the Multiplier that terminates in a Repetend, reversely make it the Multiplicand, and work as above.

If both the Multiplier and the Multiplicand terminate in a Repetend, let the Decimal repeating Figure be repeated three Times; then work as above, adding 1 for every 9.

EXAMPLES.

I. Multiply 672.5 by .365. Facit 245.4625.

$$\begin{array}{r} 672.5 \\ \times .365 \\ \hline 33625 \\ 40350 \\ 20175 \\ \hline 245.4625 \end{array}$$

Here, as the Multiplier has 3 Decimal Places and the Multiplicand 1, I point off 4 Places in the Product.

II. Multiply .456 by .123. Facit .056088.

$$\begin{array}{r} .123 \\ \times .456 \\ \hline 1368 \\ 5472 \\ \hline .056088 \end{array}$$

Here, as the Product gives but 5 Places, and there are 3 Places in the Multiplicand and 3 Places also in the Multiplier, which make 6; so, I prefix 0 to 56088 to make up the six Places.

III. Multiply 748.65 by .634. Facit 474.64762.

$$\begin{array}{r} .634 \\ \times 748.65 \\ \hline 299462 \\ 2245966 \\ 44919333 \\ \hline 474.64762 \end{array}$$

Here, as the Multiplier consists of several Figures, and the Multiplicand terminates in a Repetend; so, I make 6 and 3 conterminous to 2, before Addition.

IV. Multiply decimally £. 3 - 6 - 8 by £. 3 - 6 - 8. Facit £. 11.11

$$= £. 11 - 2 - 2 \frac{1}{2} \frac{5}{3}$$

£. 3 - 6 - 8 = 3.3: but the Repetend must be set down 3 Times, as follows:

$$A \ 2 \ 2$$

$$3.3\dot{3}$$

180 MULTIPLICATION IN DECIMAL FRACTIONS.

	3.333	Had I not repeated the Repetend, the Difference would have been as follows:
	<u>3.333</u>	
	10000	
0 being the last Figure, it is needless to make the Products conterminous with it.	10000	3.3
	10000	3.3
	<u>10000</u>	100
	11.110000	<u>100</u>
		11.00

Yet, in such a Case, if to the Product of the two Repetends, you add 2 for every 9, there is no Occasion to repeat the Repetends, nor to make the Products conterminous; for,

	3.3
Multiplied by	<u>3.3</u>
	101
	101
	<u>101</u>

Adding 2 for the 1 Nine.
Adding likewise 2 for the 1 Nine.

give the true Product 11.11

N. B. To Multiply by 10, 100, 1000, 10000, &c. you have nothing more to do but to remove the Decimal Point so many Steps farther to the Right, as there are Cyphers in the Multiplier. Thus, 34.666 multiplied by 100 will be equal to 3466.6; and .34 multiplied by 1000 = 340, &c.

MULTIPLICATION IN DECIMALS BY CONTRACTION.

Since we have, for the most Part, Occasion but for three or four Figures after the Separatrix or Dot, and sometimes the Multiplications are tedious and long, I will teach how the Work may be contracted.

RULE. Set the Units Place (of the Whole Numbers, if there are Whole Numbers, and of the Decimals, if there are only Decimals) in the Multiplier, directly under that Figure of the Decimal Part in the Multiplicand, whose Place you intend to be kept in the Product. Invert the Order of all the other Figures of the Multiplier, so that you may read it backwards; and in multiplying, begin with the Figure of the Multiplicand which stands over the Figure wherewith you are then multiplying, and set down the first Figure of every particular Product, directly under each other, contrary to the common Way, remembering at the same Time to add, to the first Figure of every Product, 1 for every Ten which would arise

MULTIPLICATION IN DECIMAL FRACTIONS. 181

arise from the Multiplication of the two next Right-Hand Figures of the Multiplicand; that is, if the Product of the next Right-Hand Figure (with as many Units added to it, as there are Tens in the Product of the second Right-Hand Figure) be any Number betwixt 5 and 15, carry 1: if 15, or any Number below 25, carry 2: if 25, or upwards below 35, carry 3: and so on in Proportion.

N. B. If the Multiplier has one or two Places more, to the Left, than the Multiplicand, you are not to set down the Product of that Figure to the Left, which has no corresponding Figure in the Multiplicand; but only add, as has been observed, for the Value of the Product of the Figure in the Multiplicand, which precedes that in the Multiplier.

EXAMPLE.

V. Multiply £. 5 - 12 - 9 by £. 3 - 6 - 3 decimally, and let there be only 3 Places in the Decimals. Facit 18.674 = £. 18 - 13 - 5 $\frac{1}{2}$.

$$\begin{array}{r} \text{£. 5 - 12 - 9} = 5.6375 \\ \text{£. 3 - 6 - 3} = 3.3125 \end{array} \quad \begin{array}{r} 5.6375 \text{ Multiplicand.} \\ 5213.3 \text{ Multiplier transverse.} \end{array}$$

$$\begin{array}{r} 5.637 \times 3 + 2 \text{ for the 15} = 16913 \\ 5.63 \times 3 + 2 \text{ for the 22} = 1691 \\ 5.6 \times (\text{nothing to carry}) = 56 \\ 5. \times 2 + 1 \text{ for the 12} = 11 \\ \text{For the 25, arising from the last Figure, add the 3 you should carry.} \end{array} \quad \begin{array}{r} 16913 \\ 1691 \\ 56 \\ 11 \\ 3 \\ \hline 18.674 \end{array}$$

Observe that, 1st, that given Number, which contains most Decimal Places, should stand for Multiplicand; and if, on the Right-Hand of the Multiplicand, there is no Figure to correspond to that of the Multiplier you are to begin to multiply by, Cyphers (or Repetends if the last is such) should be annexed to the Multiplicand to fill up the Blanks. Thus, for Instance, had you 3.2071 to be multiplied by 136.775, and to save 3 Decimal Places only; then, inverting the Multiplier, let it stand thus: 3.2071 *Multiplicand*

577.631 *Multiplier*
and, as the Multiplicand has one Place less on the Right-Hand than the Multiplier, let a Cypher fill up that Blank thus: 3.20710.

577.631
Afterwards, multiply as above, and you'll find the Product to be 438.651.

2^{dly}, If a Multiplicand, consisting of Decimals only, given to be multiplied by Decimals only, has not so many Places as it is intended the Product should consist of; then, a Cypher or Cyphers should be prefixed to it before you multiply, or else to the Product, if

if necessary to make up the Deficiency. So, if .125 were given to be multiplied by .125, and to have but 4 Decimal Places after the Separatrix, the Work must be as follows:

0.125 *Multiplicand.*

Or thus, .125

521. *Multiplier reversed.*

521.

0125

125

025

25

06

6

.0156

prefixing 0 to the Product - - .0156

☞ I would have the Learner (in order to render himself familiar with Multiplication in Decimals) go through, and work decimally, both by the common Way and by Contraction all the Questions in Multiplication of Applicate Numbers, those in Practice, and those in Multiplication of Vulgar Fractions.

DIVISION IN DECIMAL FRACTIONS.

RULE. If the Decimals are finite, divide as in Whole Numbers: but observe that; 1st, if there be as many Places in the Divisor as in the Dividend, the Quotient will be Integral; and if there be a Remainder at last, Cyphers must be added, if you design to have Decimal Parts in your Quotient. 2dly, If there be more Places in the Divisor than in the Dividend, you must annex Cyphers to the Dividend to make them equal, and the Quotient will still be Integral; and if there be a Remainder, and Decimal Parts are required, so many Cyphers more must be added to it. 3dly, If, on the contrary, there be more Places in the Dividend, you must point off as many in the Quotient to supply that Defect. 4thly, If the Whole Quotient and the Divisor be not equal in Decimal Places to the Number of those in the Dividend, then, you must prefix Cyphers to the Quotient.

If the Divisor is a single Repetend, subtract $\frac{1}{10}$ from the Dividend, then, divide by the given Divisor; or, multiply the Dividend by 9 before you divide by the given Divisor: if the Divisor has terminate Numbers joined to the Repetend, subtract the terminate Part of the Divisor from the Whole Divisor, the Remainder will be a new Divisor; and work with the Dividend as above for a new Dividend.

N. B. If the Dividend be greater than the Divisor, the Quotient will be either an Integer or a mixed Number; but if the Divisor be greater, the Quotient will be a Decimal.

EXAMPLES.

EXAMPLES.

I. Divide £. 119 - 8 - 9 by $36\frac{3}{4}$, decimally. Facit 3.25 = £. 3 - 5.

£. 119 - 8 - 9 = 119.4375; and, $36\frac{3}{4} = 36.75$, so,
 $36.75 \overline{) 119.4375} \begin{array}{r} 3.25 \\ 9187 \\ 18375 \\ 0000 \end{array}$ Here, having 4 Places of Decimals in the Dividend, and 2 only in the Divisor; 2 Places must be pointed off in the Quotient, for the Difference.

II. Divide £. 648 - 5 by $28\frac{3}{4}$, decimally. Facit 22.547 = £. 22 - 10 - 11 $\frac{1}{2}$.

£. 648 - 5 = 648.25; and, $28\frac{3}{4} = 28.75$ so,
 $28.75 \overline{) 648.25} \begin{array}{r} 22 \\ 7325 \\ 15750 \end{array}$ Here, the Places of Decimal in the Divisor being equal to those in the Dividend, the Quotient 22 is Integral; but, as there is a Remainder of 1575, so, to have Decimals I annex a Cypher continually, and divide as before.
 Rem. 1575.0 (.547 +
 $\begin{array}{r} 1375.0 \\ 2250.0 \\ 2375 \end{array}$

III. For 11s. How many lbs. of Rice, at 3d. a lb. may I have? Facit 44.

11s. = .55; and, 3d. = .0125
 $.0125 \overline{) .55.00} \begin{array}{r} 44 \\ 500 \\ 00 \end{array}$ Here, having 4 Places in the Divisor, and 2 only in the Dividend, 2 Cyphers were required to be annexed to the Dividend to make the Places equal in both; and the Quotient is Integral.

IV. Divide .063 by .12. Facit .00525.
 $.12 \overline{) .06300} \begin{array}{r} .00525 \\ 00525 \end{array}$ Here, having 3 Places in the Dividend, and 2 in the Divisor, the Quotient required 5 Places of Decimals; therefore, I prefixed 00 to 525 to make up the Deficiency.

V. Divide 13.750 by 3.6. Facit 3.75.
 The Divisor having a Repetend, and that Repetend being preceded by 3, a terminate Part,

From the Dividend . . . 13.750 and from 3.6
 Subtract $\frac{1}{10}$. . . 1.375 Subtract the Terminate . . . 3
 Remain . . . 12.375 Remain 3.3
 Then . . . 3.3) 12.375 (3.75
 $\begin{array}{r} 2.47 \\ 165 \\ 00 \end{array}$

N. B.

N. B. To divide by 10, 100, 1000, 10000, &c. you have nothing more to do but to remove the Decimal Point in the Dividend so many Steps to the Left-Hand, as there are Cyphers in the Divisor. Thus, $3466.6 \div 100 = 34.666$; and, $434.85 \div 1000 = .43485$.

DIVISION IN DECIMALS BY CONTRACTION.

RULE. Having considered in what Place the first Figure of the Quotient ought to stand, and so found its Value; take as many of the Left-Hand Figures as you intend to have Figures in the Quotient, for the first Divisor, and then take as many Figures of the Dividend as will answer them; in dividing, omit and point off one Figure of the Divisor at each Operation; remembering that, in multiplying, you are to add to the first Figure of every Product, as directed in Multiplication in Decimals by Contraction.

EXAMPLE.

VI. Divide 721.17562 by 2.257432, and let there be only three Places of Decimals in the Quotient. Facit 319.467.

$$\begin{array}{r} 2.257432 \quad 721.17562 \quad (319.467 \\ 2.257432 \times 3 \text{ (nothing to carry)} = 6.772296 \quad \text{Subtract} \end{array}$$

$$\begin{array}{r} 439460 \text{ new Dividend.} \\ 2.25743 \times 1 \text{ (nothing to carry)} = 2.25743 \quad \text{Subtract} \end{array}$$

$$\begin{array}{r} 2.13717 \text{ new Dividend.} \\ 2.2574 \times 9 + 3 \text{ for the } 27 = 2.03169 \quad \text{Subtract} \end{array}$$

$$\begin{array}{r} 10548 \text{ new Dividend.} \\ 2.257 \times 4 + 2 \text{ for the } 16 = 9030 \quad \text{Subtract} \end{array}$$

$$\begin{array}{r} 1518 \text{ new Dividend.} \\ 2.25 \times 6 + 4 \text{ for the } 42 = 1354 \quad \text{Subtract} \end{array}$$

$$\begin{array}{r} 164 \text{ new Dividend.} \\ 2.2 \times 7 + 4 \text{ for the } 35 = 158 \quad \text{Subtract} \end{array}$$

06 Remainder.

The Learner should go through and work decimally, both by the common Way and by Contraction; all the Questions in Division of Applicate Numbers and those in Division of Vulgar Fractions, in order to perfect himself in Division in Decimals.

NOTE I. Having a Multiplier, to find a Divisor; and thereby be enabled to work a Multiplication by Division only.

RULE. Divide 1, with Cyphers annexed to it, by the given Multiplier; the Quotient will be the Divisor sought.

EXAMPLE.

THE RULE OF THREE IN DECIMALS.

185

Example. What Divisor is that, by which dividing 7315, shall give a Quotient equal to the Product of the same Number, multiplied by 125? Facit .008.

$$\begin{array}{r} 125) 1.000 (.008 \\ \underline{000} \end{array}$$

And, to prove it, if you divide 7315 with as many Cyphers annexed to it, as may be necessary, the Quotient will come the same as the Product of 7315 multiplied by 125 would be.

NOTE II. Having a Divisor, to find a Multiplier; and thereby be enabled to work a Division by Multiplication only.

RULE. Divide 1, with Cyphers likewise annexed to it, by the given Divisor; the Quotient will be the Multiplier sought.

Example. What Multiplier is that, by which multiplying 7315, shall give a Product equal to the Quotient of the same Number, divided by .008? Facit 125.

PROOF of last *Example*.

$$\begin{array}{r} .008) 1.000 \\ \underline{125} \end{array}$$

And, to prove it, if you multiply 7315 by 125, the Product will come the same as the Quotient of 7315 divided by .008 would be.

THE RULE OF THREE IN DECIMALS.

RULE. After having reduced the given Vulgar Fractions or Applicate Numbers to Decimals, state your Rule of Three and work it as in Whole Numbers; observing only, in multiplying and dividing, the Rules in Decimals aforegoing.

Example I. If $\frac{1}{2}$ of a Yard cost $\frac{1}{4}$ of a £. What will $\frac{3}{4}$ of a Yard come to? Facit 15s.

Decimally—.75 : — .625 :: — .9

$$\begin{array}{r} .75) .5625 (.75 = 15s. \\ \underline{375} \\ 00 \end{array}$$

As the Answer must be less than the second Term, so I have multiplied by the less Extream and divided by the greater.

II. What Quantity of a Stuff which is $\frac{3}{4}$ Yard wide, will line $7\frac{1}{2}$ Yards of Cloth which is $1\frac{1}{2}$ Yard wide? Facit 15 Yards.

$\frac{3}{4} : 7\frac{1}{2} :: 1\frac{1}{2}$; Decimally, 1.5 : 7.5 :: .75 : 15 *Answer*; for, 7.5×1.5 less Extream, (since the Answer must be less than the second Term) = 11.25 $\div$.75 greater Extream = 15.

B b

III. If

III. If $\frac{1}{4}$ of Muslin cost 3s. What will $\frac{11}{16}$ cost? Facit .4125 = 8s. 3d.

IV. A Taylor makes a great Coat with 6 Yards of Stuff $\frac{1}{4}$ Yard wide; How many Yards of a Stuff $\frac{1}{4}$ Yard wide will line it Facit 4 Yards.

V. If for $5\frac{3}{4}$ Yards of Cloth I get £ 4 - 12; What may I reckon $84\frac{1}{2}$ Yards of the same Worth? Facit 67.6 = £. 67 - 12.

VI. If 4 Pieces cost £. 4 - 3 - 6; What will $12\frac{1}{2}$ Pieces come o? Facit 13.307 = £. 13 - 6 - 1 $\frac{3}{4}$.

☞ The Learner should go through, and work decimally, all the Questions in the Rule of Three of Applicate Numbers and Vulgar Fractions; as likewise, to perfect himself in Decimals.

SIMPLE INTEREST IN DECIMALS.

RULE. If Interest is required for one Year only, multiply the Principal by the Rate *per Cent.* with a Cypher prefixed to it; point off the Decimal Parts, and you'll have the Interest for 1 Year.

If Interest is required for several Years, after having multiplied and pointed off as above, multiply the Product by the given Number of Years; point off again the Decimal Parts, and you'll have the Interest required. And, if there be odd Time, take the Parts of the Interest of 1 Year, which add to the Worth.

Example I. What is the Interest of £. 147 - 15 for a Year, at 4 *per Cent. per Annum*? Facit £. 5 - 18 - 2 $\frac{1}{4}$.

147.75 Principal.	} Had the Rate been at 5 <i>per Cent.</i> I should have multiplied by .05; at 6 <i>per Cent.</i> I should have multiplied by .06, &c.
.04 Rate.	
5.9100 = £. 5 - 18 - 2 $\frac{1}{4}$	

NOTE. When the Rate is Fractional, the Decimal of the Fraction must be annexed to the Rate preceded by 0; thus, at $4\frac{1}{4}$ it will be .0425; at $4\frac{3}{4}$, it will be .0475, &c.

II. A Person left his Wife £. 355 - 7 - 6. which did lay in Hand $3\frac{1}{2}$ Years; I demand, What Interest is due upon it, at £. 4 $\frac{1}{2}$ *per Cent. per Annum*? Facit £. 55 - 19 - 5.

355.375 Principal $\times$.045 Rate = 15.991875 Interest of 1 Year
 $\times 3\frac{1}{2}$ Years = 55.971575 or £. 55 - 19 - 5.

☞ The Learner should go through, and work decimally, all the Questions relating to *simple Interest*; as likewise, those in *Commission, Brokage, Stock-jobbing and Insurance*; in order to perfect himself in Decimals.

COMPOUND

COMPOUND INTEREST IN DECIMALS.

RULE. Multiply the Amount of one Pound for a Year, that is, one Pound with the Decimal Rate (annexed to it as in simple Interest), by itself; the Product will be the Amount of one Pound for 2 Years: then, this Amount multiply again by the Amount of the first Year, you will have the Amount of one Pound for 3 Years; and, thus multiply continually the new Amount by that for the first Year, till you have the Amount of one Pound for the given Numbers of Years *, which last Amount of one Pound multiplied by the given Principal, will give the Amount required.

Example I. What will £. 100 amount to, if it be forborne 5 Years, at 5 per Cent. per Annum, Compound Interest? Facit £. 127 - 12 - 6 $\frac{3}{4}$.

1.05 Amount of one Pound for 1 Year $\times 1.05 = 1.1025$ for 2 Years.—

1.1025 $\times 1.05 = 1.15763$ for 3 Years.—1.15763 $\times 1.05 = 1.2155$

for 4 Years.—1.2155 $\times 1.05 = 1.27628$ for 5 Years. There-

fore, if you multiply 1.27628 by the Principal, you'll have

the Product 127.628 = £. 127 - 12 - 6 $\frac{3}{4}$.

The Learner, to exercise himself, may take the Questions of Compound Interest (Page 118) in the third Part, and work them decimally.

NOTE. But as, when the Number of Years is considerable, it would be tedious to work as many Multiplications as there are Years, so, you may work as in *Geometrical Progression*; that is, add any two or more Numbers of Years together, as make the given Number, and multiply the Amounts belonging to each Number of Years together, the Product will quote the right Amount for that given Number of Years.

Example II. What will £. 136 - 15 - 6 amount to in 20 Years, at 6 per Cent. per Annum Compound Interest? Facit £. 438 - 13 - 0 $\frac{1}{4}$.

1.06 Amount of one Pound for 1 Year $\times 1.06 = 1.1236$ for 2 Years.—

1.1236 $\times 1.06 = 1.191$ for 3 Years.—1.191 $\times 1.06 = 1.2624$ for 4

Years.—1.2624 $\times 1.06 = 1.3382$ for 5 Years.

Now, 1.3382 Amount of one Pound for 5 Years, multiplied by itself = 1.7908 for 10 Years, and 1.7908 (which is for 10 Years) multiplied by itself = 3.2071 Amount of one Pound for 20 Years.

Therefore, if 3.2071 is multiplied by the Principal 136.775, the Product will quote the right Amount, viz. 438.651 = £. 438 - 13 - 0 $\frac{1}{4}$.

* It is after this Manner that you may construct Tables, shewing the Amount of 1 £. for such a Number of Years as you please. See the following:

A TABLE *showing the Amount of one Pound for 20 Years, at 5 and 6 per Cent. Compound Interest.*

Years	5	6	Years	5	6
1	1.050000	1.060000	11	1.710339	1.898298
2	1.102500	1.123600	12	1.795856	2.012196
3	1.157625	1.191016	13	1.885649	2.132928
4	1.215506	1.262477	14	1.979932	2.260904
5	1.276281	1.338225	15	2.078928	2.396558
6	1.340096	1.418519	16	2.182874	2.540352
7	1.407100	1.503630	17	2.292018	2.692773
8	1.477455	1.593848	18	2.406619	2.854339
9	1.551328	1.689479	19	2.526950	3.025599
10	1.628895	1.790848	20	2.653298	3.207235

NOTE. If the Years are more than in the Table; then, as has been observed in the Note foregoing, add any two or more Numbers together as make the given Number, and multiply the Sums belonging to each Number of Years in the Table together; the Product will quote the right Amount of one Pound for that given Number of Years. Thus, suppose the Amount of £. 136 - 15 - 6 in the last Question had been required for 30 Years, at the same Rate of 6 per Cent. there is nothing else to do but to take any two Numbers of Years which will make 30, as for Instance 20 and 10: against 20, I find 3.207135, and against 10 I find, 1.790848; these two Amounts, multiplied together, give 5.743491; the Amount of £. 1 for 30 Years, at £. 6 per Cent. which multiplied into £. 136 775 gives 785.566 the right Amount of the given Principal for 30 Years.

There are some Varieties in Compound Interest; but, for want of Room, I must omit them; what I have treated of being, however, sufficient for common Business.

FALSE POSITION.

SINGLE FALSE POSITION

Teaches to find a Number required, by supposing at Pleasure any other which has the given Conditions.

RULE. If any Number in + (*plus* or *more*) is joined to the given Fractions, Parts or Shares, that Number must be, first, subtracted from the given Quantity; and, on the contrary, if any Number

Number in — (*minus* or *less*) is joined to the given Fractions, Parts or Shares, that Number must be, first, added to the given Quantity. Then, suppose a Number wherein may be taken all the given Parts, add the Sums of these given Parts together, afterwards say: as their Total is to the supposed Number, so, the Quantity given or Interest is to the true Number sought.

NOTE. If, in the Number, which you suppose, any of the Parts could not be taken without a Remainder; then, that supposed Number must be multiplied by that Part, and the Product will be a new supposed Number, which will hold, unless it do not contain without a Remainder some other new Parts; in which Case, multiply again that supposed Number as before by that Part, thus: was it required to know what Number whose $\frac{1}{4} \frac{1}{3} \frac{1}{7} \frac{1}{9} = 3165$. First, you may suppose 12, because $\frac{1}{4} \frac{1}{3}$ may be just taken in it; but, as $\frac{1}{7}$ can not be taken without a Remainder in that 12, so, you may multiply it by the Denominator of the Part $\frac{1}{7}$; and then, the Product will quote a new supposed Number, *viz.* 84, wherein may be taken without a Remainder the $\frac{1}{4}$ and $\frac{1}{3}$ and $\frac{1}{7}$; but, as $\frac{1}{9}$ can not be taken in that new supposed Number 84, so, you may again multiply the said new supposed Number 84 by the Denominator of the Part $\frac{1}{9}$; and then, the new supposed Number will be 756, in which may be taken without any Remainder all the Parts $\frac{1}{4} \frac{1}{3} \frac{1}{7}$ and $\frac{1}{9}$; and, as the Sums of these Parts will amount to 633, so, say: as 633 : 756 :: 3165 : 3780 *Answer*.

Yet, in such Cases, for more Ease, reduce the Fractions to a common Denominator, according to CASE X. of Reduction of Vulgar Fractions. Then, it will be as the Total of the new Numerators : the common Denominator :: the Quantity given : the Number sought.

Example 1. What is that Number whose $\frac{1}{3} \frac{1}{4}$ and $\frac{1}{6}$ make 39? Facit 36.

I suppose 12, which contains without a Remainder $\frac{1}{3} \frac{1}{4}$ and $\frac{1}{6}$.

Then, in . . . 12

$$\begin{array}{rcl} \frac{1}{3} & = & \dots 6 \\ \frac{1}{4} & = & \dots 4 \\ \frac{1}{6} & = & \dots 3 \end{array} \left. \begin{array}{l} \\ \\ \end{array} \right\} \begin{array}{l} \text{Total } 13 : 12 :: 39 \\ \text{abbreviated } 1 : 12 :: 3 \\ \text{So, } 12 \times 3 = 36 \text{ Answer.} \end{array}$$

II. A Man having a certain Number of Crowns, said: if $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ of them, and 4 more, were added together, they would make 69 Crowns. I demand how many he had? Facit 60.

$$\frac{1}{2} \times \frac{1}{3} \times \frac{1}{4} \left[\begin{array}{l} 12 \text{ New Numerator for } \frac{1}{2} \\ 8 \text{ ditto } \dots \dots \frac{1}{3} \\ 6 \text{ ditto } \dots \dots \frac{1}{4} \end{array} \right]$$

26 Total of the Numerators.

24 New Denominator,

Now,

Now, subtracting from the given Number 69, the + that is, the 4 more, say: as 26 : 24 :: 65, because $69 - 4 = 65$:

$$\text{So, } 24 \times 65 = 1560 \div 26 = 60 \text{ Answer.}$$

III. A, B and C went together to buy a certain Quantity of Timber worth £. 36. — B had $\frac{1}{3}$ more than A, and C had $\frac{1}{4}$ more than B. I demand how much each Man bought? Facit A £. 9, B £. 12, and C £. 15.

I suppose that A had £. 12 worth

$$\text{B then will have } 12 + \frac{1}{3} \text{ of } 12 = 16$$

$$\text{and C } 16 + \frac{1}{4} \text{ of } 16 = 20$$

$$48 : 12 :: 36$$

$$\text{contracted } 4 : 1 :: 36 :$$

Therefore, $36 \div 4$ will give £. 9 Answer for A

B having $\frac{1}{3}$ more than A will have 12 Answer for B

C having $\frac{1}{4}$ more than B will have 15 Answer for C

£. 36 Proof.

This, and the like Questions, can be more easily resolved by putting 1 for the supposed Number, and proceeding thus:

$$A = 1 \text{ or Reduced } \frac{3}{4} \text{ or } 3 \left. \begin{array}{l} \text{Total } 12 : 3 :: 36 : 9 \text{ A} \\ 9 + \frac{1}{3} = 12 \text{ B} \\ 12 + \frac{1}{4} = 15 \text{ C} \end{array} \right\}$$

$$B = 1 \frac{1}{3} \text{ or } \frac{4}{3} \text{ or } 4$$

$$C = 1 \frac{1}{4} + \frac{1}{4} \text{ of } 1 \frac{1}{4}, \text{ or } \frac{5}{4} \text{ or } 5$$

IV. A Man, at his Death, left £. 2600, and by his Will ordered that his Nephew should have £. 60 more than his Cousin, and his Brother as much as both his Nephew and Cousin, less £. 100. I demand what Sum each is to have? Facit the Cousin £. 645, the Nephew £. 705, and the Brother £. 1350.

If the Cousin has for his Share 1

$$\text{the Nephew will have } 1 + 60$$

$$\text{and the Brother } 2 + 60 = 100$$

$$4 + 120 = 100$$

Now, subtract from 120 100 that are less.

Remain . . . 20 more, to be taken from the Principal.

Therefore, from the Principal 2600 if you subtract the 20, there will remain £. 2580; and then, to find the Sum the Cousin is to receive, say: 4 Shares : 2580 :: 1 : 645 for the Cousin.

$$\text{Then, } 645 + 60 = 705 \text{ for the Nephew.}$$

$$\text{and, } 1350 - 100 = 1250 \text{ for the Brother.}$$

2600 Proof.

V. What

FALSE POSITION.

191

V. What is that Number whose $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{7}$ make 25? Facit 28.

VI. What is that Number whose $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{7}$, less 7, make 18? Facit 28.

VII. Two Men meeting a Flock of Sheep: One said to the other, I wonder where these 60 Sheep are going. There are not 60, replied the other; and, having counted up: Were there, said he, as many more, Half as many more and 10 besides, they then would be 60. How many were there? Facit 20.

VIII. A Man being asked how many Guineas he had in his Pocket, answered: If to what I have, you should add as many, Half as many, and $7\frac{1}{2}$ more, I would then have 130 Guineas. What Number had he? Facit 49.

DOUBLE FALSE POSITION

Teaches to find a Number required, by making Use of two supposed Numbers.

RULE. Place each Difference against its respective supposed Number. Then, multiply the Numbers supposed and their Differences cross-ways, as in CASE X. of Reduction of Vulgar Fractions. If the Differences are both greater or both less than the given Number, subtract one Difference from the other, make the Remainder your Divisor, and the Differences of their Products your Dividend; but if the Differences are mixed, that is, one greater and the other less than the given Number, let their Total be your Divisor, and the Total of their Products your Dividend.

Example I. A, B and C, are in Partnership, and have gained £. 2400. But as B, is to have £. 50 more than A; and C, £. 60 more than B; it is required to find how much each is to have? Facit A, £. 746-13-4, B, £. 796-13-4, and C, £. 856-13-4.

First, I suppose that A, should have £. 100

B, then, should have $100 + 50 = 150$

and C, should have $150 + 60 = 210$

460

less than the given Number 2400 by 1940

adly, If I suppose that A, had £. 600

B, then, should have $600 + 50 = 650$

and C, should have $650 + 60 = 710$

1860

still less than the given Number by 440

both Differences being less, the Remainder 1500 is Divisor.
The first supposed Number is 100, its Difference 1940
The second supposed Number is 600, its Difference 440

There.

Therefore, from 1040×600 or 1164000
 Subtract 100×440 or 44000

Remain for the Dividend $1120000 \div 15100 = 746.13.4$ A
 To the £. 746 - 13 - 4 add £. 50, you'll have 796 - 13 - 4 B
 To the £. 796 - 13 - 4 add £. 60, you'll have 856 - 13 - 4 C

Proof. $2400 - 0 - 0$

The same Question and the like may, more readily, be resolved by a single Supposition, and putting 1 for the Share of A, or Number supposed.

II. A Coal Merchant being asked how many Chaldrons of Coals he had sold, answered: if the Chaldrons were trebled, from the Product taking 40 Chaldrons, and to the Remainder adding $\frac{1}{3}$, he would have sold 4000 Chaldrons. How many did he sell then? Facit $1124 \frac{2}{3}$.

III. A Merchant, to set up a Manufactory, agreed with a Person, who understood well the Business, that when that Person should attend the Manufactory, he would allow him 30s. a Day: but, that the said Person was to forfeit 10s. for each Day he should not attend. At the End of 30 Days, they settled together, and the Merchant gave the other £. 25. How many Days did that Person attend, and how many Days did he not? Answer 20 Days he attended, and 10 Days he did not.

THE END OF THE FOURTH PART.

12 JU 62

THE FIFTH PART.



EXTRACTING THE ROOTS OF POWERS.

A TABLE OF POWERS.

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81
Cubes	1	8	27	64	125	216	343	512	729
Biquadr.	1	16	81	256	625	1296	2401	4096	6561
Surfolids	1	32	243	1024	3125	7776	16807	32768	59049
Squ.cubes	1	64	729	4096	15625	46656	117649	262144	531441

$\sqrt{}$ or $\sqrt{}$, prefixed to any Number, signify that the square Root of that Number is required, that is, that that Number is required to be in *the second Power*.

$\sqrt[3]{}$, prefixed to any Number, signifies that the Cube Root of that Number is required, that is, that that Number is required to be in *the third Power*.

$\sqrt[4]{}$, prefixed to any Number, signifies that the Biquadrate Root of that Number is required, that is, that that Number is required

C c

to

to be in *the fourth Power*, &c. only changing the Index Figure (which is after the radical Sign) into that of the given, or required Power.

N.B. Sometimes those Signs signify *Irrationality*, that is, that the Power of such a Number can never be truly found.

According to the foregoing Table, the Square Root of 36 is 6; and the Square Root of 81 is 9, &c.

The Cube Root of 216 is 6; and the Cube Root of 343 is 7, &c.

The Biquadrate Root of 81 is 3; and the Biquadrate Root of 4096 is 8, &c.

The Surfolid Root of 1 is 1; and the Surfolid Root of 3125 is 5, &c.

The Square Cube Root of 64 is 2; and the Square Cube Root of 531441 is 9, &c.

But, when the given Quantity exceeds those in the above Table, then, you must work according to the following Rules.

FOR EXTRACTING THE SQUARE ROOT.

RULE I. Divide the given Quantity into Periods each of two Figures, beginning by the Right Hand. Then, if the Number of Figures in the given Quantity is even, extract, or find in the Table, the Root of the two first Figures: if the Number of Figures is odd, the first Period, Left-Hand, will consist of one Figure only, whose Root you are to find in the Table.

When you have found the Root of either the first, or the two first Figures, set it down in the Quotient (for you work as in Division) and at the same Time write it over the Figure, or Figures, you work with. Then, square the Quotient, that is, multiply that Figure you have put in the Quotient by itself, and write under the Dividend the Difference betwixt its Quantity and the Product of the Multiplication, which Difference find by the Rule for working *long Division by Contradiction*.—That Operation done, proceed as follows.

II. Bring down, and join to the Remainder of the Subtraction, the next Period (or two next Figures) of the Dividend; thus you'll have a new Dividual: double the Quotient, and write the Sum over that Period; thus you'll have a new Divisor. Divide by the said Double: but observe, that the Figure you write in the Quotient, you must also annex to the Double (Divisor). Then, multiply the Divisor, or new Quantity over that Period, by the last Figure put in the Quotient, subtracting again, as in Division, the Product from the Dividual.—This repeat, till you have no more Period to work with.

NOTE I. If a new Dividual happen to be less than the Divisor, write down a Cypher in the Quotient, as also in the Divisor; then bring

bring down the next Period (or the two next Figures) of the Dividend, which, joining to the other Dividual, will form another new Dividual.

NOTE II. When any Thing remains from the Dividual of the last Period; *To nearly know the Square Root of the Remainder*; form with Cyphers three or four Periods more, which, being worked as above directed, will give you Decimals near enough the Truth: but if you have a Mind to come still nearer the Truth, annex as many more Periods of Cyphers as you please, and work as before*.

NOTE III. *To extract the Square Root of a Vulgar Fraction*, Reduce the Fraction to its lowest Term, if it be not so already; then, extract the Square Root of the Numerator for a new Numerator, and of the Denominator for a new Denominator: but observe, that if the Fraction be a *Surd*, that is, a Number where a Root cannot be exactly found, you must reduce it to Decimals, consisting of an even Number, then extract the Root.

NOTE IV. *To extract the Square Root of a mixed Number*, Reduce the Fraction into Decimals, and let the Number of Decimal Places be even: find the Square Root of the Integers, whether even or odd; then, to the Remainder of the Integers, annex the first Period of Decimals, and work as above directed; bring down another Period of Decimals, and work as before: and thus, to the end of the Periods.

FOR PROOF. Multiply the Root found, by itself; and, if the Product (after having joined to it the Remainder, if any) quotes the given Sum, the Work is right.

EXAMPLES.

I. What is the Square Root of 119059? Facit 345 + 34.

$$\begin{array}{r|l}
 \text{Divisors} & 3 \mid 6.8 \mid 68 \ 5 \\
 \text{Dividend} & 11 \mid 90 \mid 59 \ (345 \text{ Quotient or Square Root.} \\
 & \quad \quad 2.90 \\
 & \quad \quad 34.59 \\
 \text{Remainder} & \quad \quad 34
 \end{array}$$

ILLUSTRATION.

1st, The Number of Figures being 6, an even Number, I divide the Quantity into three Periods, each having a Pair of Figures (the last, to the Right-Hand, is 59; the next, to the Left-Hand, is 90; and the first, to the Left-Hand, is 11). Then I look in the Table,

* To find the Square Root of an irrational Number nearly, without the Help of Decimals, double the Remainder you'll have a Numerator; then multiply the Quotient, or Root found, by 4, to whose Product adding 1, you'll have the Denominator.

to find the nearest Square Root of the first Period 11; which being 3, I set down 3 in the Quotient, and 3 likewise over the first Period (which 3 over that first Period is to be considered as the Divisor of 11); afterwards, multiplying the Quotient 3 by itself Divisor, 3 Times 3 are 9, which subtracting from 11, the Remainder is 2 to write down under 11.

2dly, To the Remainder 2, I bring down and join 90, Figures of the next Period; and thus I have 290 for a new Dividual. Then, according to the Rules, I double the Quotient 3, and write the Sum 6 over that Period which I have just brought down, which 6 is a new Divisor of the two first Figures 29. Therefore, I say: in 29, How many Times 6? And finding there are 4 Times, I write 4 in the Quotient, which 4 I also annex to the new Divisor 6: Thus, 64 is another supposed new Divisor of 290, whose Quotient is supposed to be 4. Now, working as in *Long Division by Contraction*, I say: $4 \times 4 = 16$, and the Difference to 20 being 4, I write down 4 in the Remainder, and carry 2; $4 \times 6 = 24 + 2$ that I carry = 26, and the Difference to 29 being 3, I write down 3 in the Remainder. As I have one Period, or two Figures, more (in the given Quantity) to bring down and work with; so, according to the 2d Rule, to the Remainder 34 I annex the two Figures of that Period, viz. 59, and thus have 3459 for a new Dividual. Then I double the whole Quotient 34, and write the Sum 68, over that Period which I have just brought down, for a new Divisor. Afterwards, I say; in 34, How many Times 6? and finding there are 5 Times, I write 5 in the Quotient, and I annex the same Figure to the Divisor 68; thus, 685 is another supposed new Divisor of 3459, whose Quotient is supposed to be 5; and working as in *Long Division by Contraction*, 34 will remain.

By this Method I find that the Square Root of 119059 is 345 and 34 over, which to prove, I may multiply 345 by itself 345, taking in the Remainder 34, and I shall find the Product 119059, same Sum as the given Quantity.

II. What is the Square Root of 4847878? Facit 2201 + 3477.

$$\begin{array}{r|l}
 2. & 4.2 \mid 14.0 \mid 440.1 \\
 4. & 84 \mid 78 \mid 78 \quad (2201 \\
 & 0.84 \\
 & 0.78.78 \\
 & 3477
 \end{array}$$

In the above Operation, after having worked with the first and second Periods, I had only 78 for a new Dividual; which could not be divided by 44 + the Figure I was to put in the Quotient. Therefore, I wrote 0 in the Quotient, brought down the two other Figures 78, and thus had 7878 for another new Dividual. Then, doubling the Quotient 220, I had 440 for new Divisor; and as 4 were contained once in 7, so, I wrote 1 in the Quotient, which I have

FOR EXTRACTING THE SQUARE ROOT. 197

I have likewise annexed to 440: Thus, I had 4401 for new Divisor of 7878, and it remained 3477.

So, the Square Root of 4847878 was found to be 2201 + 3477, which may easily be proved; for, $2201 \times 2201 + 3477 = 4847878$.

III. Find the Square Root of 41111; and if there is a Remainder, find its Square Root in Decimals to three Places. Facit 202.758 + .193436.

$$\begin{array}{r|l} 2 & 4.0 \quad 40.2 \quad 404.7 \quad 4054.5 \quad 40550.8 \\ 4 & 11 \quad 11 \quad 00 \quad 00 \quad 00 \end{array} \quad (202.758$$

O.11.11

307.00 The Remainder of Whole Numbers being 307, to
.2371.00 have Decimals, I annex Periods of Cyphers, and
.34375.00 continue to work as before.

.193436 Remainder in Decimals.

FOR PROOF. I should multiply 202.758 by itself 202.758, which would produce 41110.806564, which is near enough; but to prove it entirely, I should add, to that Product, the Decimal Remainder .193436, and the Total would then quote 41111.000000, or, 41111.

IV. What is the Square Root of $\frac{16}{25}$? Facit $\frac{4}{5}$.

Here, as the Fraction $\frac{16}{25}$ cannot be reduced to lower Terms; but the Square Root of the Numerator 16 is 4, and that of the Denominator 25 is 5; so, there is no need to reduce the Fraction to Decimals, and the Square Root is found, by Inspection, to be $\frac{4}{5}$.

V. What is the Square Root of $\frac{36}{81}$? Facit $\frac{2}{3}$.

The Fraction $\frac{36}{81}$ reduced to lower Terms = $\frac{4}{9}$. Now, the Square Root will be found (without being obliged to reduce the $\frac{4}{9}$ to Decimals) to be $\frac{2}{3}$; for, the Square Root of the Numerator 4 is 2; and, the Square Root of the Denominator 9 is 3.

VI. What is the Square Root of $\frac{3}{4}$? Facit .8660 +.

Here, as the Square Root cannot be extracted exactly from the Fraction $\frac{3}{4}$; (for the Square of the Numerator cannot be found in the Table) so, I must reduce it to even Decimals: Then, I have .75, to which annexing Periods of Cyphers, I work in the following Manner:

$$\begin{array}{r|l} 8 & 16.6 \quad 172.6 \quad 1732.0 \\ .75 & 00 \quad 00 \quad 00 \end{array} \quad (.8660$$

11.00
104.00
00 44.00

Thus I find that the Square Root of .75 (or $\frac{3}{4}$) is .8660, which, if I have a Mind to prove, I must multiply by itself .8660, taking in the 4400 remaining, and the Product will be .75000000, or, .75.

N. B. If the Decimal Fraction should happen to terminate in a Repetend, instead of Periods of Cyphers, I should annex Periods of repeating Figures.

VII. What

VII. What is the Square Root of $4\frac{1}{3}$? Facit 2.1447 +.

Here, as the given Number is mixed, so, I must reduce the Fraction to Decimals, and make the Places of those Decimals even; then, I work as follows:

$$\begin{array}{r}
 2 \mid 4.1 \mid 42.4 \mid 428.4 \mid 4288.7 \mid \\
 4 \mid .60 \mid 00 \mid 00 \mid 00 \mid \\
 \hline
 0. \quad 60 \quad 19.00 \quad 204.00 \quad 3264.00 \quad 26191
 \end{array}$$

Thus, I find that the Square Root of 4.6 (or $4\frac{1}{3}$) is 2.1447, which, if I have a Mind to prove, I must multiply by itself 2.1447, taking in the 26191 remaining, and the Product will be 4.60000000, or, 4.6.

N. B. If the given Number consists of a Whole Number and Decimals together, instead of Vulgar Fractions, it is plain that the Places of Decimals must be made even, by annexing either a Cypher, or a repeating Figure, before Extraction.

VIII. What is the Square Root of 33789867618? Facit 18320 + 75218.

IX. What is the Square Root of 36372961? Facit 6031.

X. What is the Square Root of 7596796? Facit 276.228 +.

XI. What is the Square Root of 160? or, which is the same, find the Length of one Side of a Square Acre? Facit 12.64911 +.

XII. The Square Root of $17\frac{1}{2}$ is required to 3 Places of Decimals. Facit 4.183 + .2511.

XIII. What is the Square Root of $\frac{2704}{4225}$? Facit $\frac{4}{5}$.

XIV. What is the Square Root of $\frac{2304}{5184}$? Facit $\frac{2}{3}$.

XV. What is the Square Root of $\frac{271}{341}$? Facit .89802 +.

XVI. What is the Square Root of $\frac{3}{80}$, 4 Places of Decimals only being required? Facit .1936.

XVII. What is the Square Root of $11\frac{1}{2}$? Facit 3.4278 +.

XVIII. What is the Square of $6\frac{2}{3}$? Facit 2.5298 +.

XIX. What is the Square of 2.2710957? Facit 1.50701 +.

XX. What is the Square Root of .00032754? Facit .01809 +.

THE USE OF THE SQUARE ROOT,

Both in *Arithmetic* and *Geometry*.

PROBLEM I. To find a Mean Proportional between any two given Numbers.

RULE. The Square Root of the Product of the given Numbers is the Mean Proportional required.

EXAMPLES.

EXAMPLES.

I. What is the Mean Proportional between 16 and 64? Facit 32.

$$64 \times 16 = 1024, \text{ whose Square Root is } 32.$$

II. What is the Mean Proportional between 3 and 12? Facit 6.

N.B. This Problem is of excellent Use in finding the Side of a Square equal to any *Parallelogram* (a right-lined square Figure), *Rhombus*, or *Rhomboides* (a Figure having four right Angles), *Triangle* (a Figure of three Angles), or *regular Polygon* (a Figure of many regular Angles).

For if in a *Parallelogram* you suppose the two Sides: or, in a *Rhombus*, or *Rhomboides*, the Side and Perpendicular falling thereon: in a *Triangle*, the Base (that is, the Bottom, or Ground) and half the Perpendicular; or Perpendicular and half the Base: and in a *regular Polygon*, the half Perimeter or Periphery (that is, Circumference or Compass) and Perpendicular: I say, if you suppose them as two Numbers given, and by the foregoing Problem find a Mean Proportional, is the Side of a Square equal sought.

PROBLEM II. To find the side of a Square, equal in *Area* (that is, superficial Content) to any given Superficies.

RULE. The Square Root of the Content of any given Superficies is the Side of the Square equal sought.

EXAMPLES.

I. If the Content of a given Circle be 160, What is the Side of the Square? Facit 12.64911.

II. If the Area of a Circle be 750, What is the Side of the Square? Facit 27.38612.

PROBLEM III. The *Area*, or *superficial Content*, of a Circle being given, to find the *Diameter* (that is, a Line of a Circle dividing it into two equal Parts).

RULE. Say, As 355 : 452 :: the *Area* : the Square of the *Diameter*. Or, as 1 : 1.273239 :: the *Area* : the Square of the *Diameter*.

EXAMPLE.

What Length of Cord will be fit to tie to a Cow's Tail, the other End fixed in the Ground, to let her have the Liberty of eating an Acre of Grass and no more, supposing the Cow and Tail to be 5 $\frac{1}{2}$ Yards? Facit 6.136 Perches.

As 355 : 452 :: 160 *Perches* in an Acre : the square of the *Diameter*; So, $452 \times 160 = 72320 \div 355 = 203 \text{ Perches} + \frac{255}{355}$ or decimally .7183: Now, the Square Root of $203.7183 = 14.272$ *Diameter* sought; then, to find the Length of the Cord, take the

Half

Half of the Diameter, it will be 7.136 *Semi-Diameter*, from which if you subtract 1 *Perch* for the $5\frac{1}{2}$ *Yards* (Length of the Cow and Tail) there will remain 6.136 *Perches*.

PROBLEM IV. The *Area* of a Circle, or its *superficial Content*, being given, to find the *Periphery*, or *Circumference*.

RULE. Say, As 113 : 1420 :: the *Area* : the Square of the *Periphery*. Or, as 1 : 12.56637 :: the *Area* : the Square of the *Periphery*.

EXAMPLES.

I. When the *Area* is 160, What is the *Periphery*? Facit 44.839. 113 : 1420 :: 160 : 2010.619469, the *Square of the Periphery*. Therefore, from 2010.619469 extracting the Square Root, the Answer, or *Periphery*, is found to be 44.839 +.

II. When the *Area* is 12, What is the *Circumference*? Facit 12.2798.

PROBLEM V. The Sum of the Squares of two Numbers, together with the Square of the $\frac{1}{2}$ Sum being given, to find the Numbers.

RULE. From the Sum of the Squares subtract the doubled Square of the $\frac{1}{2}$ Sum, half the Remainder will be the Square of $\frac{1}{2}$ their Difference; and if to the $\frac{1}{2}$ Sum you add their half Difference, you'll have the greater Number, and if from the same $\frac{1}{2}$ Sum you subtract the same half Difference, you'll have the less Number.

EXAMPLE.

The Sum of the Squares of 2 Numbers is 3161, and the Square of their half Sum is 1560.25; What are the two Numbers? Facit 44 greater Number, and 35 less Number.

From the Sum of the Squares 3161 subtract the doubled Square of the half Sum (1560.25) which is 3120.5, the Remainder will be 40.5, the Half of which, being 20.25, is the Square of half the Difference of the two Numbers. Now, the Square Root of 20.25 being 4.5, it quotes the half Difference; and, by adding to the Square Root of 1560.25, viz. 39.5, the said Difference 4.5, you'll have 44 for the greater Number; then, by subtracting from the same Square Root 39.5, the said Difference 4.5, you'll have 35 for the less Number.

PROBLEM VI. The Sum of the Squares of two Numbers, together with the Square of their $\frac{1}{2}$ Difference, being given, to find the Numbers.

RULE. From the $\frac{1}{2}$ Sum subtract the Square of $\frac{1}{2}$ their Difference, the Remainder will be the Square of the $\frac{1}{2}$ Sum of those two Numbers: Then work as in the last.

EXAMPLES.

EXAMPLE.

The Sum of the Squares of two Numbers is 3161, and the Square of their half Difference is 20.25; What are the two Numbers? Facit 44 greater Number, and 35 less Number.

The Sum of the Squares being 3161, its Half will be 1580.5, from which subtracting 20.25, the Square of their half Difference, it remains 1560.25, whose Square Root is 39.5, which is the $\frac{1}{2}$ Sum; and the Square Root of 20.25 is 4.5. Therefore, adding 4.5 to 39.5, you'll have 44 for the greater Number; and from 39.5, subtracting 4.5, you'll have 35 for the less Number.

PROBLEM VII. The Sum of the Squares of the half Sum, and half the Difference of two Numbers, with one of them, being given, to find the other.

RULE. From the doubled Sum of the Squares subtract the Square of the given Number, and the Remainder will be the Square of the Number required.

EXAMPLE.

The Sum of the Squares of $\frac{1}{2}$ the Sum, and $\frac{1}{2}$ the Difference of 2 Numbers are 1580.5; and the less Number is 35; What is the other Number? Facit 44.

From 3161 the Double of the Squares, subtract 1225 the Square of 35, the Remainder will be 1936, whose Square Root is 44, which is the other Number.

PROBLEM VIII. Any two Sides of a right-angled Triangle being given, to find the third Side.

CASE I. *The Base and Perpendicular being given to find the Hypotenuse, or longest Side.*

RULE. The Square Root of the Sum of the Squares of the Base and Perpendicular is the Length of the Hypotenuse.

EXAMPLE.

The Height of a Castle, Town, or City Wall, &c. from the Ground is 30 Yards high, and surrounded with a Ditch 40 Yards broad; what Length must a Ladder be to reach from the outside of the Ditch to the Height of the Castle? Facit 50 Yards.

The Square of the Base, or Ditch, is 1600.

The Square of the Perpendicular, or Height, 900. } 2500

Sum of the Squares = 2500.

Now, the Square Root of 2500 is 50, the Hypotenuse, or Length required of the Ladder.

CASE II. *The Hypotenuse and Perpendicular being given, to find the Base, or Breadth of the Ditch.*

D d

RULE

RULE. The Square Root of the Difference of the Squares of the Hypothenufe and Perpendicular, is the Length of the Base, or Breadth of the Ditch.

EXAMPLE.

A Castle is furrounded by a Ditch; the Perpendicular, or Height of that Castle is 30 Yards; and to come from the outside of the Ditch to the Height of the Castle, a Ladder must be 50 Yards long: What is the Base or Breadth of the Ditch? Facit 40 Yards.

The Square of the Hypothenufe, or Length of the Ladder, is 2500
and the Square of the Perpendicular, is - - - - - 900

Difference - - - 1600

Now, the Square Root of the Difference 1600 is 40, the *Answer*.

CASE III. *The Base and Hypothenufe being given, to find the Perpendicular or Height.*

RULE. The Square Root of the Difference of the Squares of the Hypothenufe and Base, is the Height of the Perpendicular.

EXAMPLE.

A Castle is furrounded by a Ditch 40 Yards broad; and to come from the outside of the Ditch to the Height of the Castle, a Ladder must be 50 Yards long: What is the Perpendicular, or Height of that Castle? Facit 30 Yards.

The Square of the Hypothenufe, or Length of the Ladder, is 2500

The Square of the Base, or Breadth of the Ditch, is - - - 1600

Difference - - - 900

Now, the Square Root of the Difference 900 is 30, the *Answer*.

PROBLEM IX. To divide a Number given by extreme and mean Proportion.

RULE. Multiply the Square of your given Number by 5, the Product divide by 4, and from the Square Root of the Quotient subtract $\frac{1}{2}$ your given Number; the Remainder will quote the greater Part, which subtracted from the Whole, will give the less.—*As for*

EXAMPLE:

Let the given Number be 12, whose Square is 144, which multiplied by 5, produces 720, which Product divided by 4, gives 180, whose Square Root is $13\frac{2}{3}$, from which subtract 6 (the Half of your given Number), it will remain $7\frac{2}{3}$ for the greater Part, which subtracted from the whole Number 12, gives $4\frac{2}{3}$ for the less Part.

PROBLEM

PROBLEM X. Any Number of Men being given, to form them into a Square Battle, or to find the Number of Ranks and Files.

RULE. The Square Root of the Number of Men given, is the Number of Men, either in Rank or File.

EXAMPLES.

I. An Army of 32400 Men, is to be formed in a Square Battle. How many Men in Rank and File must there be? Facit 180 in Rank and 180 in File.

Extract the Square Root of 32400, and it will be found to be 180.

II. A certain square Pavement contains 48841 square Stones, all of the same Size; I demand how many are contained in one of the Sides? Facit 221.

FOR EXTRACTING THE CUBE ROOT.

To square a Number (as it has been shewn), is to multiply it once by itself. Now, to Cube a Number, is to multiply it twice by itself: Thus: the Square of 6 is 36, because $6 \times 6 = 36$; the Cube of 6 is 216, because $6 \times 6 \times 6 = 216$.

RULE I. Divide the given Quantity into Periods, each of three Figures, beginning on the Right-Hand; then, find in the Table (Page 193.) the Cube Root of the first Period, Left-Hand, whether it consists of three or two Figures, or of one Figure only; write it in the Quotient; Cube that Figure in the Quotient, and the Product subtract from the first Period *. Afterwards, bring down (and annex to the Remainder) the next Period, that is, the three next Figures.

II. First, square the Quotient, and multiply the Sum by 300. Then, divide apart, by that Product, the new Dividend, and multiply the Divisor by this Quotient.

2dly, Square this last Quotient, multiply the Sum by the other Figures in the Quotient, and the Product, multiply besides by 30; and that last Product set down under that of the above Operation.

3dly, Cube the last Quotient, and set down the Product under the two others.

4thly, Add these three Products together, and subtract the Total from the Remainder of the last Operation and the three Figures you have annexed to it: But observe, that if the three Products give a Total greater than the Dividual, you must lessen the last Figure in the Quotient of 1 or 2 Units if required. Then work again according to the four last Rules, and if a new Dividual happen to be less than the Divisor, you must write down a Cypher in the Quotient, bring down the next Period, then work as before. Observe likewise,

* This Operation is to be done only once.

that you must apply the same four last Operations, as many Times as you have Periods remaining, to bring down and work with.

NOTE I. When any Thing remains from the Dividual of the last Period, to nearly know the Cube Root of the Remainder; form with Cyphers new Periods, each consisting of 3 Cyphers, which being worked as above directed, will give you Decimals, as near the Truth as you please to continue them*.

NOTE II. To extract the Cube Root of a Vulgar Fraction; reduce the Fraction to its lowest Terms, if it be not so already; then, extract the Cube Root of the Numerator for a new Numerator, and of the Denominator for a new Denominator; but observe, that if the Fraction be a Surd, you must (as in the Square Root) reduce it to Decimals, consisting of 3, 6, 9, 12, &c. Places; then extract the Cube Root.

NOTE III. To extract the Cube Root of a mixed Number; reduce the Fraction into Decimals, and let the Decimals consist (as has been already observed) of 3, 6, 9, &c. Places. Find the Cube Root of the Integers. Then, to the Remainder annex the first Period of Decimals, and work as before; and thus to the end of the Periods.

N. B. If the Decimal Fraction should happen to terminate in a Repetend, you should annex Periods of repeating Figures instead of Cyphers.

FOR PROOF. Multiply the Root found by itself, and the Product, or Square, arising therefrom multiply again by the Root; and, if this last Product (after having joined to it the Remainder, if any) quotes the given Sum, the Work is right.

EXAMPLES.

I. What is the Cube Root of 35954? Facit 33 + 17.

First Operation.	{	Square of 3 = 9	Root
		Cube of 3 = 27	35 954(33
		Remains 8, So 8.954	8937

$$3 \times 3 = 9 \times 300 = 2700)8954(3$$

$$\text{So, } 2700 \times 3 = \quad \quad \quad 8100$$

$$3 \times 3 = 9 \times 3 = 27 \times 30 \quad 810$$

$$3 \times 3 \times 3 \quad \quad \quad 27$$

$$8937 \quad - \quad - \quad - \quad - \quad - \quad 8937$$

$$\text{Remains} \quad - \quad - \quad 17$$

* To find nearly the Cube Root of an irrational Number without the Help of Decimals, multiply the Quotient, or Root found, by 3; to the Product add 1; and the Total added to the Square of the said Root tripled will be the Denominator of the Remainder, which let stand for Numerator.

After

ILLUSTRATION.

After having found in the Table, the nearest Cube Root of 35, and subtracted the Cube of the Root from the said 35, I proceed in the following Manner: 1st, I square the Quotient 3; and the Product 9, I multiply by 300, which gives 2700 for Divisor of 8954. Wherefore, I consider what may be the Quotient of $8954 \div 2700$; and finding that it can go 3 Times, I set down 3 in the Quotient; and, at the same Time, I annex the same Figure to the Root already found. Then, I multiply the Divisor 2700 by that Figure of the Quotient, viz. 3; and the Product 8100, I set down.

2dly, The last Quotient 3, I square; and the Product 9, I multiply by the other Figure of the Root, which, being again 3, gives 27; and this Product 27, multiplying by 30, I have 810, which I set down under 8100.

3dly, The last Quotient 3, I cube; and the Product 27, I set down under the two other Products.

4thly, I add the three Products 8100, 810, and 27 together; and the Total 8937 I subtract from the Dividend 9954, which gives the Remainder 17. And as there is no other Period to be brought down, the Work is finished, unless it had been required, or I had a Mind to have Decimal Places in the Root.

Thus, I find, that the Cube Root of 35954 is 33, and 17 over; which to prove, I should cube the Root 33, thus: $33 \times 33 \times 33 = 35937$; to which adding the Remainder 17 = 35954 given Sum.

II. What is the Cube Root of 5648? Facit 17 + 735

First Operation. $\left\{ \begin{array}{l} \text{Square of } 1 = 1 \\ \text{Cube of } 1 = 1 \\ \text{Remains } 4, \text{ So, } 4.648 \end{array} \right.$

$$1 \times 1 = 1 \times 300 = 300) 4648. (7^*$$

So, $300 \times 7 = 2100$

$$7 \times 7 = 49 \times 1 = 49 \times 30 = 1470$$

$$7 \times 7 \times 7 = \dots 343$$

3913 - - - 3913

Remains - - - 735

* One would think that in 4648 it can go 15 Times 300: but as, in Division 9 only can be admitted at once in the Quotient; so, I could only suppose that it should go 9: Yet, by trying that Quotient 9, I found the three Products to amount to 5859, which is more than the Dividual 4648. It could not go 8 neither, for the three Products would have amounted to 4832, still greater than the Dividual.

EXTRACTING

EXTRACTING THE CUBE ROOT BY CONTRACTION.

RULE. After having worked according to Rule I. foregoing; 1st, Square the Quotient, and (instead of multiplying by 300) multiply the Square found by 3 for a Divisor. Find how often it is contained in the Dividual, rejecting Units and Tens (on Account of the two Cyphers cut off) and put the Answer in the Quotient. Then, Square the last Figure in the Quotient, and put the Product on the Right-Hand of the Divisor, so that the Units be two Places before the Units of the Divisor, and if there is no Ten Figure, supply its Place with a Cypher. 2dly, Triple the last Figure in the Quotient, and the Product multiply by the former Figure or Figures in the Root, whose Product put under the other Sum, Units under the Tens, add the two last Sums found as above, and the Divisor together; and multiply the Total by the last Figure in the Quotient. 3dly, Subtract that last Product from the Dividual; to the Remainder annex the next Period, then begin again to work as above directed.

III. What is the Cube Root of 99252847? Facit 463.

First Operation { 99 | 252 | 847(463
64

$$4 \times 4 = 16 \times 3 = 48$$

$$)35.2(6$$

$$35.252$$

$$6 \times 6 = \dots \dots .36$$

$$6 \times 3 = 18 \times 4 = 72.$$

$$5556 \times 6 = \dots \dots \dots 33336$$

$$46 \times 46 = 2116 \times 3 = 6348$$

$$)1916.8(3$$

$$1916.847$$

$$3 \times 3 = \dots \dots \dots .09^*$$

$$3 \times 3 = 9 \times 46 = \dots \dots 414.$$

$$638949 \times 3 = \dots \dots \dots$$

$$1916847$$

$$\text{OOCOCO}$$

ILLUSTRATION.

After having found, in the Table, the nearest Cube Root of 99 to be 4, written down that Root, and its Cube 64 subtracted from 99; to the Remainder 35, I bring down, and annex, the next

* Here, as the Square consisted of one Place only, viz, 9, I have been obliged (that I may have two Places) to prefix a Cypher to 9, according to what has been observed in Rule 1st.

Period

EXTRACTING THE CUBE ROOT BY CONTRACTION. 207

Period 252 : Thus, I have 35252 for new Dividual; with which I proceed as follows.

1st, The Root found 4 I square; and, the Product 16 multiplying by 3, I have 48 for Divisor of the Remainder and first Figure of the next Period, viz. 352. Wherefore, I seek how many Times 48 may be contained in 352, and finding it can go 6 Times, I set down 6 in the Quotient, and at the same Time I annex the same Figure 6 to the Root already found. Then, this last Quotient 6 I square, and the Product 36 I set down under the Divisor 48: But in such a Manner, that the Units be two Places before the Units of that Divisor 48, and that, being joined together, it should make 4836.

2dly, The same last Quotient 6 I triple; and the Product 18 multiplying by the other Root 4, it gives 72, which 72 I place under the other Sums, so that the Units of this be under the Tens of the last Sum. Afterwards, I add the three Sums, viz. the Divisor, considered as 4800 to the second Sum 36, and the third Sum, considered as 720, together; and the Total 5556 multiplying by the last Quotient 6, I have the Product 33336.

3dly, This Product 33336, I subtract from the Dividual 35252, and it remains 1916, to which annexing the next Period 847, I have 1916847 for new Dividual; with which I begin again to work as before, thus:

1st, The Root found 46 I square; and the Product 2116, multiplying by 3, I have 6348 for Divisor of the Remainder and first Figure of the next Period, viz. 19168. Wherefore, I seek how many Times 6348 can be contained in 19168; and, finding it can go 3 Times, I set down 3 in the Quotient; and, at the same Time, I annex the same Figure to the Root already found. Then, this last Quotient 3 I square; and, the Product 9 I should set down to the Right of the Divisor: But because there is no Ten in 9, I must supply the Place of Tens with a Cypher; and then, it is 09 which I have to set down under the Divisor 6348, in such a Manner that the Units be two Places before the Units of that Divisor 6348, and that, being joined together, it should make 634809.

2dly, The same last Quotient 3, I triple; and, the Product 9 multiplying by the other Root 46, it gives 414, which 414 I place under the other Sums, so that the Units of this be under the Tens of the last Sum. Afterwards, I add the Divisor, considered as 634800, the second Sum 09, and the last Sum considered as 4140, together; and the Total 638949 multiplying by the last Quotient 3, I have the Product 1916847.

3dly, This Product 1916847 I subtract from the Dividual 1916847, and it remains nothing. Now, there being no other Period to bring down, the Work is finished; and I conclude that the Cube Root of 99252847 is 463; which may easily be proved, for 463 cubed, i. e. $\times 463 \times 463 = 99252847$ given Sum.

- IV. What is the Cube Root of 12812904? Facit 234.
 V. What is the Cube Root of 27135225149? Facit 3005+34.
 VI. What is the Cube Root of 6912 in Integers and two Decimal Places, if there be a Remainder? Facit 19.04+.9588736.
 VII. What is the Cube Root of 282 in Integers and three Decimal Places? Facit 6.557+.86709307.
 VIII. What is the Cube Root of 7612181.7612? Facit 196.71+.
 IX. What is the Cube Root of 7612.812161? Facit 19.67+.
 X. What is the Cube Root of .001906624? Facit .124.
 XI. What is the Cube Root of .053258279? Facit .376.
 XII. What is the Cube Root of $\frac{8}{27}$ to three Decimal Places? Facit .908+.
 XIII. What is the Cube Root of $\frac{338}{8}$? Facit $\frac{7}{2}$.
 XIV. What is the Cube Root of $\frac{1}{9}$? Facit .822+.
 XV. What is the Cube Root of 25 $\frac{1}{4}$? Facit 2.9481.
 XVI. What is the Cube Root of 8 $\frac{1}{11}$? Facit 2.013+.

THE USE OF THE CUBE ROOT.

The Cube Root is of great Use in Mathematics: But as I intended to treat of mercantile Computations only, so, I shall only give a few Problems.

PROBLEM I. To reduce any Solid to a Cube; or, to find the Side of a Cube that shall be equal to any given Solid, as a Globe, Cylinder, Prism, Cone, or such like.

RULE. The Cube Root of the Solid Content of any Solid Body given, is the Side of a Cube, whose Solidity shall be equal to that of the Figure given.

Example I. Suppose the Content of a Globe were found to be 15625 Solid Inches, What is the Side of a Cube of equal Capacity? Facit 25.

In 15625 the Cube Root is 25. *Answer.*

II. Suppose a Box, or Chest, whose Length is 24, Breadth 9, and Depth 8 Inches; required the Side of a Cube whose Solid Content shall be equal thereto? Facit 12.

Length 24 $\times$ 9, Breadth = 216 $\times$ 8, Depth = 1728, whose Cube Root being 12 is the Answer.

PROBLEM II. Having the Dimensions of a Solid given, to find out the Dimensions of a similar, or like Solid, that shall be any Number of Times greater less than that given.

RULE. Cube the given Dimensions; and, multiply their several Cubes by the Difference, if the Solid required is greater than the given one; but, divide the several Cubes by the Difference, if the Solid required is less than the given one.

Ex. There is a cubical Vessel, whose Side is 12 Inches, and it is required to find the Side of that Vessel which shall contain 3 Times as much. Facit 17.306.

The Cube of $12 = 1728 \times 3$ Difference $= 5184$, whose Cube Root being 17.306, is the Answer.

PROBLEM III. Between two Numbers given, to find two Mean Proportionals.

RULE. Multiply the less Extream by the Cube Root of the Quotient of the greater Extream divided by the less, the Product will quote the Less of the two Mean Proportionals; which multiplied by the said Cube Root, gives the greater Mean sought.

Ex. What are the two Mean Proportionals between 6 and 162? Facit 18 and 54.

162 greater Extream $\div$ 6 less Extream $= 27$, whose Cube Root is 3; by which multiplying 6, the less Extream, you'll have 18 for the less Mean; and 18×3 the same Root $= 54$ the greater Mean.

PROBLEM IV. To find out the Dimensions of a similar Solid, by having the Dimensions or Capacity of a similar Solid given.—The following Examples will serve as Directors for resolving any Question of the kind.

Ex. I. If a Ship of 100 Tuns be 44 Feet long at the Keel, of what Length shall the Keel of a Ship of 220 Tuns be? Facit 57.225. Say; as 100 Tuns : the Cube of 44, viz. 85184 Feet :: 220 Tuns : 187404.80 Feet whose Cube Root being 57.225 is the Length of the Keel required.

II. The Keel of a Ship is 125 Feet, and the Breadth of the midship Beam 25 Feet, and the Depth of the Hold 15 Feet; What must be the Dimensions of another Ship of the same Figure, that shall carry three Times the Burthen of the given Ship? Facit 215.9 Feet for the Length of the Keel, 36 Feet for the Breadth of the midship Beam, and 21.6 Feet for the Depth in the Hold.

The Cube Roots, of the Cubes of the respective given Dimensions multiplied by 3, will produce the several Dimensions required.

III. Required the Side of a Cube that will be equal in Capacity to a Vessel which contains 1728 solid Inches? Facit 12.

The Cube Root in 1728 is 12, the Answer.

IV. Suppose a Cannon-Ball, 3 Inches Diameter, to weigh 54 Ounces Avoir-du-Poids; What must the Diameter of that Mould be, in which another Ball, weighing 27 Pounds, may be cast? Facit 6 Inches.

As 54 oz. : $3 \times 3 \times 3$ or 27 Inches :: 27 lbs. or 432 oz. : 216, whose Cube Root is 6 Inches, the Answer.

V. If a Bullet of Brass, of 8 Inches Diameter, weigh 72 lbs. What will a Bullet of Brass weigh, whose Diameter is 4 Inches? Facit 9 lbs. Since like Solids are in triple Proportion to their homologous Sides, Diameter, Lines, &c. Say; as the Cube of the Diameter of the 8 Inches, viz. 512 Inches : 72 lbs. :: the Cube of the Diameter of the 4 Inches, viz. 64 Inches : 9 lbs. the Answer.

E e

VI. Sup-

VI. Suppose a Ship 150 Tuns Burden, and the Dimensions as follow: 65 Feet by the Keel, 18.5 by the Beam, and as much Depth in the Hold; by which a Carpenter is to proportion the Dimensions of another Ship of 1200 Tuns Burden: Required the Length of her Keel, and other Dimensions in Proportion? Facit 130 Feet the Length, 37 the Breadth, and 37 the Depth.

First, $150 : 65 \times 65 \times 65 :: 1200 : 2197000$ whose Cube Root is 130 the Length. 2dly, $65 : 18.5 :: 130 : 37$ the Breadth and Depth.

A general RULE for EXTRACTING the ROOTS of all POWERS.

After having prepared the Quantity given for Extraction, by dividing it from the Units Place into Periods, each containing as many Figures as the Root required directs, *viz.* 2 Figures for the Square Root, 3 Figures for the Cube Root, 4 Figures for the Biquadrate Root, &c.—After having likewise found the first Figure in the Root, by the Table of Powers (p. 193.), and subtracted its corresponding Value from the first Period, to the Remainder annex the first Figure of the next Period: Thus, you'll have a *supposed Dividual*. Then, proceed according to the two following RULES:

I. Involve the Root already found (whether it consists of 1 or more Figures) into the next inferior Power to that which is given (that is; multiply it by 1 only, if it is the Square Root which is required; Square it only, or multiply it once by itself, if it is the Cube Root which is required; Cube it, or multiply it twice by itself, if the Biquadrate Root is required, &c.) Then, multiply the Product by the Index of the given Power (that is; by 2, if it is a Square Root; by 3, if it is a Cube Root; by 4, if it is a Biquadrate Root, &c.), and this last Product call the *Divisor*.

II. Find a Quotient Figure by common Division, and annex it to the Root. Bring down all the Periods you have already worked with, including that whose first Figure you have annexed to the last Remainder. Then, involve the whole Root into the whole given Power (that is, multiply all the Figures of the Quotients, or Roots, already written down, by themselves; once, if it is a Square Root; twice, if it is a Cube Root; thrice, if it is a Biquadrate Root, &c.) The Product arising therefrom (which you may call *Subtrahend*) subtract from the Sum of all the Periods you have just brought down. To the Remainder annex the first Figure of the next Period, if any remains to be brought down; and you'll have a new *supposed Dividual*, with which begin again to work according to the two above-given Rules. Finally, the Product of the last Operation subtract from the whole given Quantity.

EXAMPLES:

EXAMPLES.

I. What is the Biquadrate Root of 19987173376? Facit 376.

First Operation $\left\{ \begin{array}{l} 19987173376(3 \\ 81 \end{array} \right.$

3 cubed only = 27×4 . Index = - 108) 118.8(7⁺ Quo. and new Rt.

From the two first Periods - - 1998717
Subtract the Biquadrate of 37, viz. $\left\{ \begin{array}{l} = 1874161 \end{array} \right.$
 $37 \times 37 \times 37 \times 37$ - - -

27 cubed = 50653×4 Index = 202612) 124556.3(6

From the three Periods - - - 19987173376
Subtract $376 \times 376 \times 376 \times 376 =$ - - 19987173376

0000000000

ILLUSTRATION.

Here, as it is the Biquadrate Root which is required; so, after having found the Biquadrate Root of the first Period, and subtracted the Value of that Root from the said first Period, I have brought down and annexed the first Figure of the next Period, to have a Dividual. Then, to have a Divisor, I have cubed the Root found (that is, multiplied it twice by itself), because the inferior Power to the fourth, or Biquadrate, is the third or Cube; and multiplied the Product by 4, because the Index of the Biquadrate Root is 4. Afterwards, I have brought down all the Figures of the first and second Periods for a Minuend; and, to get the Subtrahend, I have multiplied the Roots by themselves thrice, because it is the Biquadrate Root which is required. Then, as it remained another Period to work with, I have brought down its first Figure, annexed it to the Remainder, and began again to work as before, to get the Divisor and the Subtrahend.

II. What is the Cube Root of 53157376? Facit 376.

The Answer of the above Question may be found by working as in the first; except that, as, here it is the Cube Root only which is required to be extracted, so, to have the Divisors, instead of cubing the Roots, or multiplying them twice by themselves, you are only to square them, or multiply them once by themselves, because the in-

* It seems it could go 8 Times: But, by trying that Figure, I found it cannot go 8 Times, because, with that Figure, the next Operation would amount to more than the Sum I am to subtract from. Therefore I set down in the Quotient, and annex to the other Root already found, 7 only.

212 CROSS MULTIPLICATION, OF DUODECIMALS.

ferior Power to the third or Cube, is the second or Square; and the Index to multiply by must be 3 only, because the Index of the Cube Root is 3: then, to get the Subtrahends, the Roots must be multiplied by themselves twice only.

III. What is the Square Root of 141376? Facit 376.

The Answer of this Question may likewise be found by working as in the first; except that, as, here it is the Square Root only which is required to be extracted, so, to have the Divisors, the Roots are not to be multiplied by themselves, because the inferior Power to the second or Square being the first, should you multiply by 1, it would give only the same Quantity; the Index to multiply by must be 2, because the Index of the Square Root is 2: then, to get the Subtrahends, the Roots must be multiplied by themselves once only.

The above 3 Examples being well understood, the following Questions, and others of higher Powers, will, by the same Rules, easily be resolved.

IV. What is the Square Root of 12544? Facit 112.

V. What is the Cube Root of 115501303? Facit 487.

VI. What is the Biquadrate Root of 56249131561? Facit 487.

VII. What is the Biquadrate Root of 84934656? Facit 96.

VIII. What is the Surfolid Root of 6436343? Facit 23.

IX. What is the Biquadrate Root of 21743271936? Facit 384.

X. What is the Surfolid Root of 8349416423424? Facit 384.

XI. What is the Square Cube Root of 3206175906594816? Facit 384.

XII. What is the second Surfolid Root of 75144747810816? Facit 96.



CROSS MULTIPLICATION, OF DUODECIMALS.

RULE. Take the less Sum, or that which consists of a less Number of Denominations, for Multiplier; and place that Multiplier so that the highest of its Denominations be under the lowest of the Multiplicand. Then, multiply all the Denominations in the Multiplicand (beginning from the lowest Denomination) by the highest Denomination of the Multiplier; observing to carry to the Product of the next Superior 1 for every 12*. Multiply in the same Manner all the Denominations in the Multiplicand, by the next lower of the Multiplier; observing only, that you are to begin

* In this Rule the Ratio is 12 every where, thus: 12 Fourths make 1 Third; 12 Thirds make 1 Second; 12 Seconds make 1 Inch or Prime, and 12 Inches make 1 Foot.

CROSS MULTIPLICATION, OF DUODECIMALS. 213

to set down the Product under that Figure of the Multiplier which you are then multiplying by.—Thus, Feet multiplied by Feet, will produce Feet. Feet multiplied by Inches (or Primes); or, Inches multiplied by Feet, will produce Inches; Feet multiplied by Seconds will produce Seconds; Inches or Primes, multiplied by Inches or Primes, will produce Seconds; Inches multiplied by Seconds will produce Thirds; Seconds multiplied by Seconds will produce Fourths, &c.

The Questions may also be resolved either by Practice or by Decimals, according to the following Directions.

By Practice. Place the less Sum for the Multiplier. Then, multiply the Figures in the Multiplicand by the Feet in the Multiplier; and for the rest of the Multiplier, take Part or Parts in the Multiplicand.

N. B. When Feet happen to be large in either or both of the Factors, the Operation will be more easily worked by Practice than by the other Rule.

By Decimals. Reduce the Inches and Parts into Decimals; then work as in Multiplication and Valuation of Decimals.

EXAMPLES.

I. What is the Product of 7 Feet 9 Inches, multiplied by 1 Foot 9 Inches? Facit 13 Feet 6 In. 9".

<i>F. In.</i>	<i>By Practice</i>	<i>By Decimals.</i>
7.9 1 f. 9 In.	7 . 9 1 . 9	7.75 1.75
7.9 × 1 = 7.9	7 . 9	
7.9 × 9 = 59 . 9	3 . 10 . 6	3875
13.6 . 9	3 In. = $\frac{1}{2}$ of 6 1 . 11 . 3	5425
	13 . 6 . 9	775
		13.5625

II. Multiply 3 F. 10 In. 6", by 1 F. 9 In. Facit 6 F. 9 In. 4" 6".

<i>F. In. "</i>	<i>By Practice</i>	<i>By Deci.</i>
3.10.6 1 f. 9 In.	3 . 10 . 6 1 . 9	3.875 1.75
3.10.6	3 . 10 . 6	19.75
2.10.10 . 6	1 . 11 . 3	65875
6.9.4.6	3 In. = $\frac{1}{2}$ of 6 0 . 11 . 7 . 6	6.78125
	6 . 9 . 4 . 6	

III. Multiply

214 MENSURATION OF SURFACES AND SOLIDS.

III. Multiply 7 F. 5 In. 9", by 3 F. 5 In. 3". Facit 25 f. 8 In. 6". 2''' . 3'''.

$$\begin{array}{r}
 7 \cdot 5 \cdot 9 \\
 3 \cdot 5 \cdot 3 \\
 \hline
 22 \cdot 5 \cdot 3 \\
 3 \cdot 1 \cdot 4 \cdot 9 \\
 1 \cdot 10 \cdot 5 \cdot 3 \\
 \hline
 25 \cdot 8 \cdot 6 \cdot 2 \cdot 3
 \end{array}$$

IV. Multiply 8 F. 1 In. by 3 F. 5 In. Facit 27 F. 7 In. 5".

V. Multiply 2. 1. 9". by 8. 6. Facit 18. 2. 10. 6'''.

VI. Multiply 97. 8. by 8. 9. Facit 854. 7.

VII. Multiply 7. 3. 2. by 1. 7. 3. Facit 11. 7. 9. 11. 6'''.

VIII. Multiply 75. 9. by 17. 7. Facit 1331. 11. 3.

IX. Multiply 8. 6. 9. by 7. 3. 8. Facit 62. 6. 7. 9.

X. Multiply 179. 3. by 38. 10. Facit 6960. 10. 6.



MENSURATION of *Surfaces* and *Solids*.

Of *SURFACES*.

Surfaces are measured by the superficial *Inch*, *Foot*, or *Yard*, according to the stated Measures of different *Countries*, and the Measures peculiar to different *Artists*, as *Carpenters*, *Plasterers*, *Surveyors* of Land.—The superficial *Inch*, is any small Surface of 1 *Inch* Length and Breadth; and because 12 *Inches* make 1 *Foot* of Long Measure, 144 *Inches* (Square of 12) make 1 superficial *Foot*; 9 *Feet* (Square of 3) make 1 *Yard*; 30 $\frac{1}{4}$ *Yards* (Square of 5 $\frac{1}{2}$) make 1 *Rod*, *Pole*, or *Perch*; 40 *Poles* make 1 *Rood*; and 4 *Roods* make 1 *Acre* of Land Measure.

The superficial Content of any Surface is found by Rules adapted to its particular Figure, whether *Square*, *Triangle*, *Polygon*, or *Circle*.

CASE I. To find the *Superficial Content*, or *Area* of *rectangular Square Figures*, whether *equal* or *oblong*.

RULE. Multiply the *Length* by the *Breadth*; and the Product will give the Content of the same Name with the Dimensions taken, either *Inches*, *Yards*, or *Feet*, accordingly.

Example I. What is the superficial Content of a Board 15 *Feet* 6 *Inches* long, and 3 *Feet* 6 *Inches* broad? Facit 54 *Feet* 3 *Inches*.

By

this Diagonal from one of the opposite Angles, 12 Chains 30 Links, and from the other opposite Angle, 9 Chains, 25 Links; What is the Content in Acres? Facit 24 Acres, 0 Roods, 21 Perches + .760.

The Perpendicular 12 *Ch.* 30 *Lin.* added to the other Perpendicular 9 *Ch.* 25 *Lin.* = 21 *Ch.* 55 *Lin.* which multiplied by half the Diagonal, *viz.* 11 *Ch.* 20 *Lin.* the Product is 241.36 Square Chains; this divided by 10 Square Chains in an Acre, give 24 Acres, and .136 remaining. Now, to bring that Remainder into Roods and Perches, multiply it by 4, you'll have .544 then by 40, you'll have 21.760. Thus the Answer will be found to be 24 *Ac.* 0 *Roods*, 21 *Per.*

Observe that all irregular Polygons are in the same Manner divided into Triangles; and the Content of each found, and added into one Sum.

Regular Polygons are distinguished by the Number of equal Sides: thus, a Figure having 5 equal Sides and 5 equal Angles, is termed a *Pentagon*; a Figure having six equal Sides is called *Hexagon*.

CASE IV. To find the *Area*, or *superficial Content* of any *Polygon*.

RULE. Take $\frac{1}{2}$ the Circumference, or the Length of one Side, multiplied by $\frac{1}{2}$ the Number of Sides: multiply this by the Perpendicular falling from the Centre of the Figure of any of the Sides; and the Product will be the Answer.

Example in Paviers Work. Suppose a Piece of Pavement in the Form of a regular Hexagon, the Length of the Side 35 Feet, the Perpendicular 30 Feet, 4 Inches; What will be the Area in superficial Yards? Facit 353 Feet, 6 Inches.

35 Length of one Side $\times$ 3 half the Number of Sides in a Hexagon = 105 the Half Circumference which $\times$ 30 Feet, 4 Inches Perpendicular = 3181 Feet, 6 Inches, this divided by 9 Feet in a Yard = 353 Feet, 6 Inches the Answer.

CASE. V. To find the *Area*, or *superficial Content* of a *Circle*.

RULE. Square the Diameter; and multiply the Product by this constant Decimal Factor .7854, which expresses the Area of a Circle whose Diameter is Unity.

Example. Suppose a Table round and circular, 5 Feet Diameter: Required its Area in Square Feet. Facit 19.635 Feet.

5 Feet Diameter squared or multiplied by itself $5 = 25 \times .7854 = 19.635$. Were it an oval Table, 6 Feet long and 4 broad, the Content would be 18.849 for $6 \times 4 = 24 \times .7854 = 18.8496$.

OF SOLIDS.

Solids are measured by the Solid *Inch*, *Foot*, or *Yard*. A Solid, or cubical Inch, is a Body of a Die Figure, its Length, Breadth, and Depth being 1 Inch; 1728 of these Inches, that is $12 \times 12 \times 12$ make one cubical Foot, and 27 cubical Feet make one cubical Yard.

MENSURATION OF SURFACES AND SOLIDS. 217

Also 282 Solid Inches make 1 Gallon English Ale Measure; 231 Inches make 1 Gallon Wine Measure; 210 Inches make 1 Malt Bushel; 40 Solid Feet make 1 Tun of Wood.

The Solid Content of any Body is found by Rules adapted to its particular Figure.

CASE I. To find the *solid Content* of *Cubes* and *Parallelopipedons* *.

RULE. Multiply the Length by the Breadth, and that Product by the Depth.

Example I. What is the Content in Malt Bushels of a Chest 40 Inches long, 20 Inches broad, and 15 deep? Facit 5.581.

$40 \text{ Length} \times 20 \text{ Breadth} = 800 \times 15 \text{ Depth} = 12000 \text{ Inches}$, which divided by 2150 Inches in a Malt Bushel, gives 5.581 +

II. What is the Content in solid Feet of a Log equal at both Sides, the Length 16 Feet, 6 Inches, and 14 Inches every Way by the Side (or, as Carpenters term it, 14 Inches Square)? Facit 22.46 Feet.

First, square 14, that is, $14 \times 14 = 196$. Then, say: as 144 Inches: the Length 16.5 Feet :: 196 Inches: the Answer in Feet. $16.5 \times 196 = 3234$, which divided by 144, gives 22.45 +

CASE II. To find the *solid Content* of *Prisms* (*oblong Solids* or *Bodies*) of all Kinds, whether *square*, *triangular*, or *Polygonal*.

RULE. Find the superficial Content, or Area of the Base, as in Surfaces, by the proper Rule; this multiplied by the Length or Height of the Prism, gives the solid Content.

Example. What is the Content in Ale Gallons of a triangular Prism, the triangular Base whereof is 36 Inches in the Side, and 24 Inches by the Perpendicular falling on that Side, the Altitude being 40 Inches?

$\frac{1}{2}$ of the Base 36, viz. 18×24 the Perpendicular $= 432 \times 40$ the Height $= 17280$, this divided by 282 Inches in one Ale Gallon, gives 61.27 Gallons, the Answer.

N. B. Pyramids may be reduced to the same Rule, being $\frac{1}{3}$ of their circumscribing Prism.

The Segments of Pyramids, as are all square Logs, greater at one End than at the other, are generally measured, by Carpenters, in the following Manner.—Take the Girt of the Log in the Middle, $\frac{3}{4}$ Part of which note down; multiply it by itself taken in Inches, then say: as 144: the Length of the Log in Feet :: that Product: the Content in Feet.

Example. Suppose a square Log, 60 Inches round in the Middle, and 24 Feet long; What is its Contents in solid Feet; and how

* Called so, because they are contained under six Surfaces, the opposite ones whereof are parallel and equal.

218 MENSURATION OF SURFACES AND SOLIDS.

many Tuns of Wood are contained in 20 of these Logs? Facit 37.5 Feet the Content of one Log; and 18 Tuns, 30 solid Feet, in the 20 Logs.

First, $\frac{1}{4}$ of 60 Inches the Girt = 15, which multiplied by itself 15, gives 225; 2dly, 144 : 24 the Length :: 225 : 37.5 the Content of one Log, which multiplied by 20, the Number of Logs = 750. now dividing 750, the Content in Feet of 20 Logs, by 40 solid Feet in a Tun of Wood, it gives the Number of Tuns required, viz. 18 Tuns + 30 solid Feet.

CASE III. To find the *solid Content of Cylinders.*

RULE. Multiply the Square of the Diameter by the Decimal .7854; that Product multiply by the Length either in Feet or Inches: but observe, that if you multiply by the Length in Feet, the Product must be divided by this constant Divisor 183.34, which is a Gauge Point for solid Feet in round Timber, arising from the Division of 144 by .7854: and if you multiply by the Length in Inches, the Product must be divided by this constant Divisor 2200.15, which is a Gauge Point also for solid Feet, arising from the Division of 1728 by .7854.

Example. What is the solid Content of an equal round Piece of Timber, 14 Inches Diameter, and 5 Feet long? Facit 5.345 Feet before the Stobs are taken off. Diameter 14 Inches squared = 196 $\times$ 5 the Length taken in Feet = 980 $\div$ 183.34 = 5.345 Answer. Or, 196 $\times$ 60 the Length taken in Inches = 11760 $\div$ 2200.15 = 5.345 same Answer.

By this Rule, all round Timber, whether equal at both Ends or not, is readily measured by the Pen, the Diameter in the Middle being known: but when the Diameter is unknown, the Circumference in the Middle only being given; that Diameter may be found by this Proportion: as 22 : 7 :: the Circumference : Diameter.

Suppose a round Log, 15 Feet long, and the Circumference in the Middle 66 Inches, required its solid Content in Feet before the Stobs are taken off. Facit 36.08.

As 22 : 7 :: 66 the Circumference : 21 the Diameter. Now, 21 squared = 441 $\times$ 15 the Length in Feet = 6615 $\div$ 183.34, as above, = 36.08 Feet.

CASK GAUGING.

RULE. After having taken the Dimensions of the Cask in Inches; namely, the Diameter at the Bung, the Diameter at the Top, and the Length of the Cask; first, subtract the Top Diameter from the Bung Diameter, and write down the Difference; then, if the Staves of the Cask are much curved and bulging between the Bung and the Top, multiply the Difference by the Decimal .7: if they do not bulge

bulge so much, multiply the said Difference by .65 (instead of .7); if they bulge yet less, multiply by .6 : if they are straight, or almost straight, multiply by .55; add the proper Product to the Top Diameter; the Sum will be a mean Diameter, by which the Cask is reduced to a Cylinder: 2dly, Square the mean Diameter thus found; then multiply by the Length of the Cask. 3dly, Divide the Product by 359 for Beer or Ale Gallons, or by 294 for Wine Gallons.

Example I. What is the Content in Ale Gallons of a round Hog-head, the Bung Diameter 48 Inches, the Top Diameter 36 Inches, the Length 60 Inches, and the Staves of the Cask much curved and bulging? Facit 329.47.

First, 48 Bung Diameter — 36 Top Diameter = 12 remaining Difference, which multiplied by .7 = 8.4 to be added to the Top Diameter 36 = 44.4 the mean Diameter.

2dly, The mean Diameter found 44.4 squared = 1971.36, which multiplied by the Length of the Cask 60 = 118281.60.

3dly, The Product 118281.60 divided by 359 for Ale Gallons = 329.47, the Answer.

Ex. II. What is the Content in Wine Gallons of a Pipe 36 Inches by the Bung, 26 by the Top, 54 Inches long, and the Staves of the Cask not much curved? Facit 188.08.

First, 36 Bung Diameter — 26 Top Diameter = 10 remaining Difference, which multiplied by .6 = 6 to be added to the Top Diameter 26 = 32 the mean Diameter.

2dly, The mean Diameter found 32 squared = 1024, which multiplied by the Length of the Cask = 54 = 55296.

3dly, The Product 55296 divided by 294 for Wine Gallons = 188.08.

A SHORT COLLECTION OF DIVERTING QUESTIONS.

I. A charitable, Person meeting some Beggars, draws his Purse, and intends to give each of them 6*d.* but upon counting his Money, he finds that he has not enough by 4*d.* He gives each of them only 5*d.* and then he has 3*d.* over. I demand, How many Beggars were there, and how much Money he had? Facit 7 Beggars, and 38*d.*

Such Question as this is properly resolved by Algebra: but the Answers may easily be gotten by this RULE.—Add the two Differences together, the Total will quote the Number sought of Beggars (or the like); then, the Money is found by Multiplication and Subtraction.

*In the above Question, the Difference in — is 4*d.* and the Difference in + is 3*d.* which added together = 7, the Number of Beggars. Now, if he gives 6*d.* to each, he must have 42*d.* (for $7 \times 6d = 42$): but, since he had not enough by 4*d.* then subtracting from 42*d.* the 4*d.* you'll find had 38*d.* which is easy to prove, for, by giving each 5*d.* he disburses 35*d.* only, and therefore must have 3*d.* over.*

220 SHORT COLLECTION OF DIVERTING QUESTIONS.

II. A Man being asked how many Guineas he had, said: A certain Number, multiplied by 8, would produce 7 more than I have: but, if the same Number be multiplied by 7 only, it will make 5 less than I have. What is that Number, and how many Guineas had he? *Answer*, 12 is the Number to be multiplied, and 89 are the Number of Guineas the Man had.

The Answers are to be found as in the first Question.

III. The Master of a reputable Academy intends to buy the House he lives in, by what his Scholars shall pay him. If they give him for Instruction £. 6 only *per Annum*, he should want £. 75 more: therefore, to answer his Purpose, he intends to make his Scholars pay £. 7 *per Annum*; and then he will have £. 83 too much, which will, as he observes, serve him to make some necessary Repairs. How many Scholars has he, and how much will the House cost? *Answer*, he has 158 Scholars, and the House will cost £. 1023.

The Answers of this Question are again to be found as in the first.

IV. A Man meeting some Beggars, found, that,—should he give each of them 7d. he would be 26d. short of serving them all; and by giving each 5d. he would have 18d. over. Required the Number of Beggars, and how many Pence he had. *Answer*, 22 Beggars and 128d.

Such Question as this is resolved by this

RULE. When what is given does not differ by Unity, after having added, as in the first Question, the Differences together, divide their Total by the Difference betwixt the two Numbers which cause the Differences, and the Quotient will quote the Number required of Beggars (or the like). As to the Money, it is found (as in the first Question) by Multiplication and Subtraction.

Here, therefore, the Differences 26 and 18 = 44 which divided by 2 Difference between 7 and 5 = 22, The Number of Beggars.

Now, to give 7d. to each of the 22 Beggars, the Man should have 154d. but as, at that Rate, he would be 26d. short, so, if from 154d. you subtract the 26d. the Remainder will be 128, which must be the real Number of Pence he had.

V. The Colonel of a Regiment, after a Review, intending to reward some of his Soldiers, finds that if he give each 1s. 6d. he will be 2s. 6d. short. Therefore he gives each 1s. only, and then he has 3s. over. How many Soldiers were rewarded, and how much Money had he? *Answer*, 11 Soldiers, and 14 Shillings.

This Question is to be resolved in the same Manner as the last, except that the Differences must be brought to Pence, to be enabled to find out the Number of Soldiers.

VI. Two Women, A. and B. have some Eggs. If B. give A. one of her's, then A. will have the Double of B.: on the contrary, if A. give B. one of her's, both, then, will have an equal Number. How many had each? *Answer*, A. 7, and B. 5.

SHORT COLLECTION OF DIVERTING QUESTIONS. 221

To Prove it. If to 7 you add 1, A. would have 8; and, from 5 subtract 1, B. would have only 4, which is the Half of 8, and solves the first Supposition.—And, if from 7 you subtract 1, A. will have only 6; and to 5 add 1, B. will have also 6; which solves the second Supposition.

Wherefrom arises this RULE. When what is to be added and subtracted is above Unity (or less than Unity) to have the Number of that which is to have the Double, multiply what is given to be added or subtracted by 7; and to have the Number of that which is to bring the Equality, multiply what is given by 5.

VII. Peter giving to John 6 of his Shillings, John will have the Double of Peter: but, if John gives 6 of his to Peter, they will have both as many. Required how many Peter has, and how many John has. Answer, John 42, and Peter 30.

For John, multiply the 6s. by 7; and, for Peter, multiply the 6s. by 5.

VIII. If A. give B. £. 363 - 17 - 11¹/₇, B. will have the Double of A. But, if B. give the same Sum to A. then, A. will have just as much as B. What Sum have they both? Answer, B. £. 547 - 5 - 6, and A. £. 1819 - 9 - 7¹/₂.

PART II.

ARITHMETIC IN APPLICATE NUMBERS.

F I N I S H
12 JU 62

PART III.

VARIETIES IN PROPORTION.

127	The Rule of Five, or Double
128	Rule of Three
129	The Rule of Hundred
130	Simple Interest
131	Compound Interest
132	Commission
133	Stock Jobbing
134	Brokerage
135	Rebate, or Discount
136	Arithmetical Progression
137	Geometrical Progression
138	Permutation

CONTENTS.

CONTENTS.

PART I.

ARITHMETIC IN WHOLE NUMBERS.

I ntroduction - - - Page	1	Multiplication - - - Page	20
Notation or Numeration - - -	2	Division - - - - -	33
Addition - - - - -	4	The Rule of Three - - -	43
Subtraction - - - - -	10	—Ditto by <i>Contraction</i> - -	46

PART II.

ARITHMETIC IN APPLICATE NUMBERS.

Tables of <i>Money, Weights, and Measures</i> - - - - -	49	Division - - - - -	73
Addition - - - - -	54	Reduction - - - - -	77
Subtraction - - - - -	63	—The Use of <i>Reduction</i> - -	82
Multiplication - - - - -	68	The Rule of Three - - -	87
		Practice - - - - -	91

PART III.

VARIETIES IN PROPORTION.

The Rule of Five, or Double Rule of Three - - -	105	Equation of Payments - -	127
The Rule of Hundred - -	107	Barter - - - - -	128
Simple Interest - - - -	111	Tare and Trett - - -	128
Compound Interest - - -	117	Exchange - - - - -	132
Commission - - - - -	119	Fellowship - - - - -	138
Stock-jobbing - - - -	ibid.	Conjoined Proportion - -	140
Brokerage - - - - -	121	Alligation, or Rule of Mix- tures - - - - -	142
Rebate, or Discount - -	ibid.	Arithmetical Progression -	147
Loss or Gain - - - - -	123	Geometrical Progression -	149
Insurance - - - - -	125	Permutation - - - - -	151

PART

C O N T E N T S.

P A R T I V.

FRACTIONAL ARITHMETIC.

Of Vulgar Fractions Page 153 Reduction - - - 154 Addition - - - 161 Subtraction - - - 162 Multiplication - - 164 Division - - - 165 The Rule of Three - 167 Of Decimal Fractions - 168 Reduction - - - 169 —To find by Inspection, the Decimals of Shillings, Pence, and Farthings - - 172 —To find, by Inspection, the Value in Shillings, Pence, and Farthings of any Decimal 175	Addition in Decimal Fractions Page 176 Subtraction - - - 177 Multiplication - - - 178 —Ditto by Contraction 180 Division - - - 182 —Ditto by Contraction 184 —To find the Product of a Multiplication by Division only <i>ibid.</i> —To find the Quotient of a Division by Multiplication 185 The Rule of Three - - <i>ibid.</i> Simple Interest - - 186 Compound Interest - - 187
Single false Position - - 188	Double false Position - - 191

P A R T V.

A Table of Powers - 193 Forextracting the Square Root 194 The Use of the Square Root - 198 For extracting the Cube Root 203 Ditto by Contraction - - 206 The Use of the Cube Root - 208	For extracting the Roots of all Powers - - - 210 Cross Multiplication - - 212 Mensuration of Surfaces - 214 Ditto of Solids - - 216 Diverting Questions - - 219
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E R R A T A.

E R R A T A.

Page.

- 27 *Ex.* of Case IV. in the Proof, the Half of 2409, read = 1204 $\frac{1}{2}$.
- 32 *Quest.* XII. read multiply 9409, and in XIII. read by 14315.
- 62 *Quest.* V. for Total, read £. 795 - 18 - 5 $\frac{1}{2}$.
- 65 *Ex.* VIII. in the second Sum, read 3978 - 18 - 5 $\frac{3}{4}$.
- 66 For *Rem.* of the *Ex.* for Wine Measure, read 17. 60. 3.—for
Rem. of the 1st. *Ex.* of Long Measure, read 8 - 1 - 11.—
for *Rem.* of the 1st. *Ex.* of Time, read 28. 26. 17.—and for
Rem. of the 2d. *Ex.* of Time, read 29. 21. 41.
- 67 *Quest.* VI. read and I have in Cash only £. 614 - 5 - 6.
- 72 In the Total of the *Ex.* read 7d. instead of 9.
- 77 *Quest.* IX. read £. 756 - 13 - 6.
- 86 *Quest.* XVI. read in 3914d. instead of 15645; and *Quest.* XXII.
after *Facit*, read 36 cwt. 3 qrs. 6 lbs. 7 oz. 14 dr.
- 114 *Ex.* VIII. after *Facit*, read £. 5 - 8 - 11 $\frac{1}{4}$ —in the Product,
read 2178 - 15.—in the Amount for the first Year, read
21 - 15 - 9.—and in the Quotient, read 13 Weeks, =
5 - 8 - 11 $\frac{1}{4}$.
- 115 *Quest.* X. read at 3 per Cent. instead of 5.
- 118 *Ex.* I. in the Interest of the second new Principal, read
26 - 19 - 3 $\frac{3}{4}$ —for the last new P. read 476 - 8 - 1 $\frac{1}{4}$ —
and for the Product of 6, read 2858.8.7 $\frac{1}{2}$.
- 126 *Ex.* of Case IV. read Insurance Home £. 24 - 3 - 11 $\frac{1}{4}$ —and
for Total Insurance 46 - 8 - 4 $\frac{1}{2}$.
- 131 In *Ex.* III. read each 7 cwt. 1 qr. 14 lbs.
- 134 In the Product of Merradies, 2 Lines before *Ex.* VI. read 2108.
- 137 *Quest.* XVIII. read a Bill of £. 754 - 10.—in the 3d Line fol-
lowing read also £. 754 - 10. *Quest.* XIX. read *Facit* £. 754 -
10; and in the Line following read the same £. 754 - 10.
- 151 Line 16, no Need to divide by it, read no Need to divide.—and
in *Ex.* I. of Permutation, read it would last 55 Years, 71 $\frac{1}{4}$
Days.
- 162 *Quest.* VI. read *Facit* I. $\frac{993}{1120}$.—*Quest.* XII. read *Facit* 29 Bush.
2 Pec. 1 Gal. + $\frac{1}{15}$.
- 163 *Quest.* XI. read *Facit* 3 Pecks, 6 Pints.
- 164 *Quest.* III. read *Facit* $\frac{320}{850}$; and *Quest.* V. read *Facit* 498 $\frac{31}{40}$.
- 165 *Quest.* XVII. read at £. 6 - 16 - 4.
- 166 *Quest.* III. read divide $\frac{320}{850}$.
- 195 In the Divisors, 2d Period, read 6.4 instead of 6.8.
- 208 *Quest.* V. read + 24; and *Quest.* XIII. read of $\frac{324}{100}$ instead of
 $\frac{250}{686}$.

12 JU 62

